CORPS OF ENGINEERS

Limited Energy Study
Thermal Storage at
Central Chilled Water Plant
Fort Leonard Wood, Missouri

FINAL SUBMITTAL

May 31, 1996

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THERMAL STORAGE AT
CENTRAL CHILLED WATER PLANT
FORT LEONARD WOOD, MISSOURI
930073-0017

May 31, 1996

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SECTION 1

EXECUTIVE SUMMARY

A. Introduction

The Scope of Work (See Appendix A) called for the study of the economic feasibility of providing a cold thermal storage system at the central chiller plant serving the Fort Leonard Wood 600 Area in order to reduce electrical demand charges.

In the Entry Interview, Mr. Doug Cage requested that the analysis include the potential for expansion of such a system to serve the 700 and 800 Areas as well. It was agreed that this would be done if the analysis indicated that a cold thermal storage system would be economically feasible for Area 600. Essentially, the systems are modular in nature, so that installed costs would be a multiple of the number of Areas served, not including any extraordinary costs which might be incurred as a result of special conditions which might be encountered as a result of system expansion.

B. Building Data

The 600 Area study area is comprised of two different build types, mess halls and barracks. The mess halls are all essentially identical with the exception that site orientation varies by building. The same is true for the barracks buildings. The following table summarizes building data.

BUILDING TYPE	QUANTITY	FLOOR AREA EACH
Barracks	10	25,878 sq.ft.
Mess Hall	4	7,140 sq.ft.

C. Present Energy Consumption and Demand

A baseline case was calculated under the basis that the future chilled water plant for the area under analysis would be served by a centrifugal chiller. this was done because there is no existing baseline condition against which thermal storage systems may be compared. The existing chiller serves Area 600 plus a portion of Area 700. In addition, its age is such that it is reasonable to expect that it will be replaced in the near future. Assuming that replacement would be done by centrifugals is, we believe, both reasonable and proper.

Electrical energy and demand data for this "Base Case" are as follows:

Peak electrical demand:	679 KWD
Peak energy demand:	2,317,000 BTUH
Annual demand charge costs:	$50,395

Annual electrical usage:	1,436,000 KWHR
Annual energy usage:	4,900,000,000 BTU
Annual energy cost:	$35,895

Total annual utility cost= $86,290
(demand plus usage)

No fuels other than electricity are involved in this study.

D. Energy Conservation Analysis

1) ECO's Investigated

There are two main approaches to cold thermal storage, and both of these were evaluated. One approach uses what is termed an "ice-harvesting" or "ice-shucking" approach, in which thin layers of ice are cyclically built-up on vertical plates and dropped off into a bin below. This bin of ice chips then becomes the means of providing chilled water. The other approach will typically freeze ice in a solid block, perhaps around a bank of pipes during the ice building phase. At the end of the ice building phase, the pipes will circulate water through them which gradually melts the build-up ice, and simultaneously chills the water passing through them. We have referred to these systems as "ice tanks."

The ice harvesting system has the benefit of being able to simultaneously provide chilled water while it continues to build ice. No separate ice-build time is needed. The ice tank system cannot do this. Therefore, for buildings which require cooling at night (such as the Barracks), a separate conventional chiller is required for this duty so that the ice tanks can recharge. The cost and effect of this extra chiller has been included in ice tank calculations.

For each system several combinations of chiller"run"/chiller"off" hours over a 24 hour day were evaluated. Each combination became a separate ECO. Such combinations result in variations in thermal storage volume requirements, chiller plant tonnages needed, and energy consumption. These combinations were generated in order to arrive at the optimum for both first cost and energy consumption.

ICE HARVESTING SYSTEMS

Appendix C contains manufacturer's literature for a typical ice harvesting system. Five alternative systems were evaluated, utilizing various combinations of run time vs. off times, and in addition varying the amount of time the systems ran making ice to the amount of time they ran as conventional chillers. The five systems analyzed are summarized in the following table.

ECO#	HOURS MAKING ICE	HOURS AS CHILLER	HOURS "OFF"
IH-1	8	16	0
IH-2	8	10	6
IH-3	12	12	0
IH-4	12	6	6
IH-5	8	13	3

The ice harvesting system has the ability to continue to produce chilled water during the hours it is in the ice-making mode, due to the fact that the generated ice is de-coupled from the ice-making apparatus. It is therefore available as a separate chilling source. Therefore, the columns labeled as "hours making ice" should not be interpreted as though chilled water cannot be produced during those hours. It simply means that the mechanical refrigeration system will be making ice during those periods.

ICE TANK SYSTEMS

Appendix C contains manufacturer's literature for a typical ice tank system. As with the ice harvesting systems, a total of five alternative systems were evaluated with different mixed of chilling, ice-building, and off hours over a 24-hour period. The following table summarizes these combinations:

ECO#	HOURS MAKING ICE	HOURS AS CHILLER	HOURS "OFF"
IT-1	8	16	0
IT-2	11	13	0
IT-3	8	10	6
IT-4	11	7	6
IT-5	11	10	3

2) ECO's Recommended

None of the ECO's can be recommended.

3) ECO's Rejected

None of the ECO's met the required SIR hurdle of 1.25 and therefore all ECO's are rejected. The conclusion is that cold thermal storage is a non-feasible approach to reducing utility costs at Fort Leonard Wood. The reasons for this are very basic.

First, cold thermal storage systems are extremely expensive to install, compared to

conventional chilled water generators such as centrifugal chillers. The difference in first costs can be amortized over a reasonable period of time, but only if demand and energy charges avoided are high, such as exist on the east coast of the United States. However, the rates being charged at Fort Leonard Wood are among the lowest in the country. The table on page 3-3 from the 7/95 issue of Energy User News reflects this. It shows that, at the current rate of 2.50 cents per KWHR, had Ft. Leonard Wood's utility company been included in this list it would have been one of the cheapest rates in the country, ranking in the top 2.5% of those listed. While this table reflects energy charges only, it is generally the case that energy rates and demand rates go hand-in-hand. Such systems can also be made feasible if the local utility has financing or cash contribution incentives which can be applied against first costs. However, the local utility has no such programs available.

A contributing factor which hurts the viability of cold thermal storage is the need to have cooling available at night for the Barracks building. Most cold thermal storage systems are successfully employed only on buildings which have a regular "down time" such as office buildings, which are closed at nights and over weekends. Such downtime allows the ice system to devote itself exclusively to re-charging of the ice tanks, without the need to simultaneously provide cooling. A need for concurrent cooling drives the installed cost of the system up very significantly.

4) ECIP Projects Developed

None. See Table 1.1 at end of this Section.

5) Non-ECIP Projects Developed

None. See Table 1.1 at the end of this Section.

6) Operational or Policy Change Recommendations

None. Thermal storage is not economically attractive for Fort Leonard Wood.

E. Energy and Cost Savings

See Table 1.2 at end of this Section.

ECO	COST($)	ANNUAL ENERGY SAVINGS*	ANNUAL COST SAVINGS**	SIR	SIMPLE PAYBACK PERIOD(YRS)	ANALYSIS DATE
IH-1	948,394	11.3	$ 9,485	.15	99.99	8/21/95
IH-2	2,231,477	-209.9	$43,070	.28	51.81	8/21/95
IH-3	938,656	- 15.2	$ 9,500	.14	102.91	8/21/95
IH-4	1,174,666	-216.8	$42,898	.54	27.38	8/21/95
IH-5	1,067,969	- 54.4	$46,956	.65	22.74	8/21/95
IT-1	536,849	11.3	$15,200	.42	35.32	8/21/95
IT-2	648,009	74.1	$19,963	.46	32.46	8/21/95
IT-3	1,048,431	9.4	$48,552	.69	21.59	8/21/95
IT-4	968,714	41.6	$49,356	.76	19.63	8/21/95
IT-5	759,010	50.3	$49,574	.97	15.31	8/21/96

* Savings are in units of thousand of watt-hrs per year.
** Includes savings due to electrical demand charge avoidance.

TABLE 1.1

LIFE CYCLE COST ANALYSIS SUMMARY

ECO	TOTAL POTENTIAL ENERGY SAVINGS*	TOTAL POTENTIAL COST SAVINGS**	PERCENTAGE OF ENERGY CONSERVED	ENERGY USE BEFORE IMPLEMENTATION*	ENERGY USE AFTER IMPLEMENTATION*
IH-1	226	$141,412	0.8%	28716	28490
IH-2	-4198	$635,640	-14.6%	28716	32914
IH-3	-304	$135,338	-1.1%	28716	28120
IH-4	-4336	$632,896	-15.1%	28716	33052
IH-5	-1088	$697,342	-3.8%	28716	29804
IT-1	226	$226,452	0.8%	28716	28490
IT-2	1482	$298,903	5.2%	28716	27234
IT-3	188	$722,684	0.7%	28716	28528
IT-4	832	$735,463	2.9%	28716	27884
IT-5	1006	$738,911	3.5%	28716	27710

* Units are in thousand of watt-hour.
** Includes savings due to electrical demand charge avoidance.

TABLE 1.2

ENERGY AND COST SAVINGS SUMMARY

(Note: Negative numbers indicate that ECO consumed more energy than base case.)

SECTION 2

METHODS USED AND SOURCES OF INFORMATION

The Scope of Work (See Appendix A) called for the study of the economic feasibility of providing a cold thermal storage system at the central chiller plant serving the 600 Area in order to reduce electrical demand charges.

In the Entry Interview, Mr. Doug Cage requested that the analysis include the potential for expansion of such a system to serve the 700 and 800 Areas as well. It was agreed that this would be done if the analysis indicated that a cold thermal storage system would be economically feasible for Area 600. Essentially, the systems are modular in nature, so that installed costs would be a multiple of the number of Areas served, not including any extraordinary costs which might be incurred as a result of special conditions which might be encountered as a result of system expansion.

The areas in question are comprised of multiples of two different building types, Mess Halls and Enlisted Men Two-Company Barracks. Architectural drawings were obtained for these buildings and each building type was entered into the Trane "Trace 600" computer program in order to determine the building's daily cooling load profiles. Buildings were entered for each of the three Areas, in their proper quantity and orientation. In order to establish daily cooling load profiles, load curves were estimated for the two building types for both lighting and occupancy. The major factor in determining daily cooling load profiles, however, was skin loading due to shifting solar loads and varying outside air temperature.

Load profiles were then applied to several different potential types of central chiller plants (ECO's) each with their own capacities, efficiencies, and run time periods. Applying these loads to each system was done through the "Trace 600" program, and resulted in the calculation of energy usages over the cooling season.

There are two main approaches to cold thermal storage, and both of these were evaluated. One approach uses what is termed an "ice-harvesting" or "ice-shucking" approach, in which thin layers of ice are cyclically built-up on vertical plates and dropped off into a bin below. This bin of ice ships then becomes the means of providing chilled water. The other approach will typically freeze ice in a solid block, perhaps around a bank of pipes during the ice building phase. At the end of the ice building phase, the pipes will circulate water through them which gradually melts the built-up ice, and simultaneously chills the water passing through them. We have referred to these systems as "ice tanks".

The ice harvesting system has the benefit of being able to simultaneously provide chilled water while it continues to build ice. No separate ice-build time is needed. The ice tank system cannot do this. Therefore, for buildings which require cooling at night (such as the Barracks), a separate conventional chiller is required for this duty so that the ice tanks can recharge. The cost and effect of this extra chiller was included in ice tank calculations.

In addition, for each system several combinations of chiller"run"/chiller"off" hours over a 24 hour day were evaluated. Such combinations result in variations in thermal storage volume requirements, chiller plant

tonnages need, and energy consumption. These combinations were generated in order to arrive at the optimum for both first cost and energy consumption.

Finally a baseline case was calculated under the basis that the future chilled water plant for the area under analysis would be served by centrifugal chiller. This was done because there in no valid existing baseline condition against which the thermal storage systems may be compared. The existing chiller serves only Area 600 and a portion of Area 700. In addition, its age is such that it is reasonable to expect that it will be replaced in the near future. Assuming that replacement would be done by centrifugals is, we believe, both reasonable and proper.

The energy and demand rates used in our cost calculations were those incremental rates which the Fort would fall under assuming no change in other normal daily summer base electrical usage. These figures were obtained directly from the electric utility company which serves the base.

Implementation cost estimates have been prepared for each ECO. Sources of cost estimate data include vendors of the various system types being analyzed and the most recent issues of the electrical and mechanical copies of the R.S. Mean Estimating Guidelines.

All load and energy consumption calculations were performed using the Trane "TRACE 600" program. The TRACE program is a professionally recognized and proven computer program that integrates architectural features with heating systems. It is capable of simulating the features, systems, and thermal loads of the building components under study. It uses NOAA weather data files and performs calculations by condensing those files into several "typical" days per month.

Cost estimates were generated through use of schematic design layouts, quotes from vendors and manufacturers for significant pieces of equipment or services, and the 1995 copies of the Means' Estimating Cost Data books.

Life cycle cost calculations were performed using the LCCID program as stipulated in the General Scope of Work.

We were informed that the chilled water plant is typically brought on in mid-May and is left on-line until mid-September. The TRACE program does not have a means of scheduling equipment run periods from mid-month to mid-month, and so the four month period of June through September was used for all calculations.

Regarding total personnel occupancies, the analysis used the scenario in which all barracks were staffed to their design capabilities, assuming a period of major required readiness. This was done also for the mess halls. During the course of a typical day, population within the barracks was allowed to fluctuate, assuming a large part of the building remained occupied due to the classrooms contained therein. Mess halls were generally left unoccupied except for the regular scheduled eating hours during which design occupancies were used.

As stated earlier, there were several points to be considered when deciding what system configurations should be evaluated.

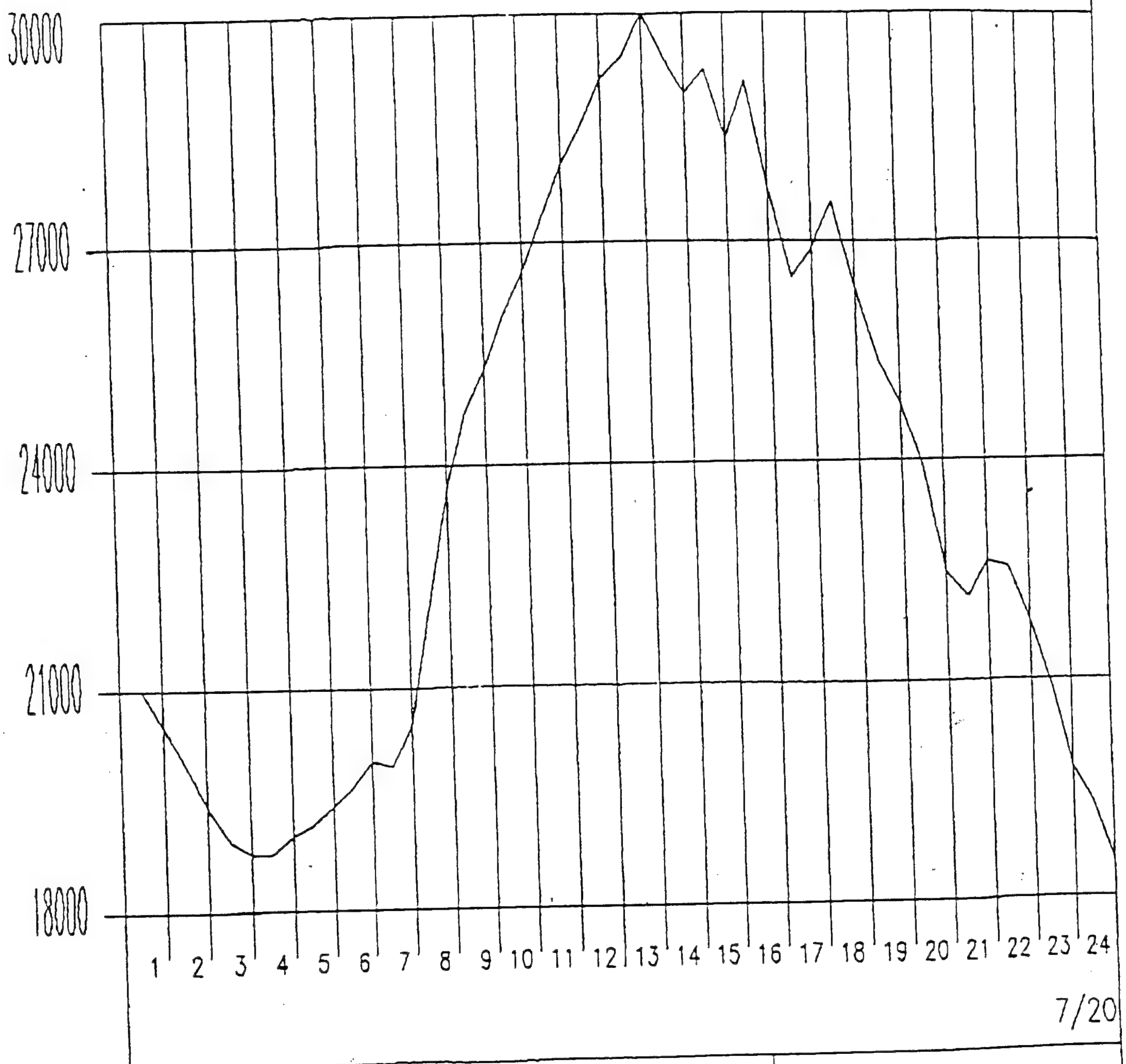
The most important consideration is the avoidance of incurring electrical demand charges. Since the concern is to avoid establishing new high demand levels, the key point is that chiller plant demand will only be an issue during that time of the day (mid-afternoon) when total Fort electrical demand is at its highest. Therefore, not running chillers and their required auxiliary motors (such as cooling tower fans and condenser pumps) during these hours can be very beneficial. A curve of historical peak Fort electrical demand was obtained from the utility and became the basis for estimating those hours for chiller "off" times which would be of value. A copy of this demand curve is on the next page.

Another consideration involved how many hours of the day the system will run in the ice-making mode compared to how long it will run in the normal chiller mode, and whether it will be turned off during the peak demand hours of mid-afternoon. The longer it is "off", the more ice-storage capacity which must be designed into the project. On the other hand, if the amount of ice storage is reduced, the cooling capacity of the chiller will be driven upward in order to supplement the thermal capacity of the stored ice. Again, this drives up first cost.

In conclusion, there is no simple means of determining which (if any) combination of run times, off periods, and thermal storage capacities is the "best". It involves a multiple run cut-and-try approach. This is what was done in both the ice harvesting and ice tank systems. Please refer to Appendix B for a detailed discussion of how this procedure was carried out.

Run Date: 1/25/95

FT WOOD TOTAL SYSTEM PEAK



PC-GRAPH

Customer ID: FT WOOD

PLOT: MONTHLY

Date: 7/20/94- 7/20/94

KW d 18514-29999

SECTION 3

RESULTS

Appendix G contains the conceptual cost estimates for each of the ECO's and the Base Case. Equipment sizes were determined from the cooling load calculations and costs were obtained from sales engineers representing manufacturers. Installation costs were taken from the 1995 Means Estimating Guides, and allowances were made for associated materials such as piping and insulation. In addition, costs were factored in for associated work and burdens such as controls, balancing, and project manuals and start-up. Markup rates of 10% for overhead and profit and 15% for contingencies were added to estimate totals.

The LCCID program approaches this type of project by comparing ECO costs to ECO savings. As a result, since this is in effect a replacement project, data was entered for each of the ECO's by entering the difference in construction costs between the ECO and the Base Case as the ECO cost, and the utility cost difference between the ECO and the Base Case as the ECO savings. An economic life of 20 years was used for the analysis.

Utility costs entered were taken directly from the ICO utility cost summaries tabulated in Appendix E. No meaningful non-energy recurring or non-recurring costs are anticipated that would be distinguishable between any of the ECO's and the Base Case.

The resulting LCC Analysis Printouts for the 10 ECO's are presented in Appendix H, and are summarized below:

ECO	Total Investment*	Total Discounted Savings	Simple Payback Period (Yrs)	SIR	Adjusted I.R.R.
IH-1	$ 948,394	$ 141,412	99.99	.15	-6.35
IH-2	2,231,477	635,640	51.81	.28	-3.27
IH-3	938,656	135,338	102.91	.14	-6.51
IH-4	1,174,666	632,896	27.38	.54	-.14
IH-5	1,067,969	697,342	22.74	.65	.83
IT-1	536,849	226,452	35.32	.42	-1.35
IT-2	648,009	298,903	32.46	.46	-.91
IT-3	1,048,431	722,684	21.59	.69	1.10
IT-4	968,714	735,463	19.63	.76	1.59
IT-5	759,010	738,911	15.31	.97	2.86

*Compared to Base Case

As can be seen, none of the ECO's meet the required SIR hurdle of 1.25, including the "optimized" cases. The conclusion is that cold thermal storage is a non-feasible approach to reducing utility costs at Fort Leonard Wood. The reasons for this are very basic.

First, cold thermal storage systems are extremely expensive to install, compared to conventional chilled water generators such as centrifugal chillers. The difference in first costs can be amortized over a reasonable period of time, but only if demand and energy charges avoided are high, such as exist on the east coast of the United States. However, the rates being charged at Fort Leonard Wood are among the lowest in the country. The accompanying table, from the 7/95 issue of Energy User News, reflects this. It shows that, at the current rate of 2.50 cents per KWHR, had Ft. Leonard Wood's utility company been included in this list it would have been one of the cheapest rates in the country, ranking in the top 2.5% of those listed. While this table reflects energy charges only, it is generally the case that energy rates and demand rates go hand-in-hand. Such systems can also be made feasible if the local utility has financing or cash contribution incentives which can be applied against first costs. However, the local utility has no such programs available.

A contributing factor which hurts the viability of cold thermal storage is the need to have cooling available at night for the Barracks buildings. Most cold thermal storage systems are successfully employed only on buildings which have a regular "down time" such as office buildings, which are closed at nights and over weekends. Such downtime allows the ice system to devote itself exclusively to re-charging of the ice tanks, without the need to simultaneously provide cooling. Such a need for concurrent cooling drives the installed cost of the system up very significantly.

RANKING OF ELECTRICITY PRICES — INDUSTRIAL

Rank	Cts/kwh	State	UTILITY	Cum kwh
1.	12.71	Hi	Hawaii Elec. Light	0.0%
2.	11.20	NY	Consolidated Edison	0.1%
3.	10.86	Hi	Maui Electric	0.2%
4.	9.98	NH	P.S. New Hampshire	0.4%
5.	9.82	Ma	Commonwealth Elec.	0.4%
6.	9.21	RI	Blackstone Valley Elec.	0.5%
7.	8.87	Ct	United Illum.	0.6%
8.	8.78	Hi	Hawaiian Electric	1.0%
9.	8.51	Ma	W. Massachusetts Elec.	1.1%
10.	8.49	NJ	Jersey Central P&L	1.6%
11.	8.46	Ma	Boston Edison	1.8%
12.	8.30	NJ	Atlantic City Electric	1.9%
13.	8.21	Ca	Los Angeles Dept W&P	2.6%
14.	8.21	Me	Central Maine Power	3.1%
15.	7.80	NJ	Public Service E&G	4.2%
16.	7.64	Ct	Connecticut L&P	4.7%
17.	7.63	RI	Narragansett Elec.	4.8%
18.	7.51	Pa	Peco Energy	6.8%
19.	7.42	Me	Bangor Hydroelectric	6.9%
20.	7.12	NY	Orange/Rockland Utils.	7.0%
21.	6.64	CA	Sacramento MUD	7.5%
22.	6.51	Ca	S. Calif. Edison	10.2%
23.	6.41	Vt	Central Vermont P.S.	10.3%
24.	6.38	Az	Tucson Elec. Power	10.7%
25.	6.32	Oh	Cleveland Elec. Illum.	11.6%
26.	6.20	Ca	San Diego G&E	12.0%
27.	6.17	Ca	Pacific G&E	14.5%
28.	6.15	Ma	Massachusetts Elec.	15.0%
29.	6.10	Il	Commonwealth Edison	17.9%
30.	5.85	Oh	Ohio Edison	19.2%
31.	5.84	Pa	Duquesne Light	19.6%
32.	5.71	Ak	Golden Valley Elec.	19.6%
33.	5.58	Md	Delmarva P&L	19.6%
34.	5.53	Ms	Mississippi P&L	20.0%
35.	5.50	Mi	Detroit Edison	21.8%
36.	5.45	Ar	Arkansas P&L	22.5%
37.	5.43	Vt	Green Mountain Power	22.6%
38.	5.40	Pa	Pennsylvania P&L	23.8%
39.	5.38	Mi	Consumers Power	25.4%
40.	5.35	Nv	Sierra Pacific Power	25.8%
41.	5.31	NM	PS New Mexico	25.8%
42.	5.29	Az	Arizona PS	26.4%
43.	5.18	Ga	Cobb Electric	26.4%
44.	5.07	NY	Niagara Mohawk Pwr.	27.9%
45.	5.06	NY	Central Hudson G&E	28.0%
46.	5.05	NC	Fayetteville PW	28.1%
47.	5.04	NC	Carolina P&L	29.5%
48.	5.02	Md	Baltimore Gas & Elec.	31.1%
49.	5.00	Fl	Florida Power	31.5%
50.	4.98	Tn	Volunteer Elec Coop	31.5%
51.	4.94	WV	Potomac Edison	31.6%
52.	4.92	Ks	Kansas City P&L	31.7%
53.	4.91	Fl	Florida P&L	32.1%
54.	4.89	Al	Huntsville agency	32.3%
55.	4.88	Oh	Columbus S. Power	32.7%
56.	4.87	Tn	Nashville Elec. Svc.	33.4%
57.	4.86	Ks	Western Resources	34.1%
58.	4.85	ND	MDU Resources	34.1%
59.	4.85	SC	Carolina P&L	34.5%
60.	4.85	Tn	Knoxville Agency	34.8%
61.	4.80	Wa	Puget Sound P&L	35.3%
62.	4.79	Ga	Jackson Elec.	35.4%
63.	4.79	Il	Illinois Power	36.4%
64.	4.77	Nv	Nevada Power	36.9%
65.	4.70	Pa	West Penn Power	37.9%
66.	4.69	NC	Virginia E&P	38.1%
67.	4.66	Mi	Indiana/Mich. Pwr.	38.2%
68.	4.64	Md	Potomac Electric	38.2%
69.	4.61	ND	Otter Tail Power	38.3%
70.	4.59	Tx	Austin agency	38.4%
71.	4.59	La	Gulf States Utilities	39.4%
72.	4.58	Tn	Chattanooga agency	39.8%
73.	4.57	Co	PS Colorado	40.5%
74.	4.57	Wi	Northern States Power	40.8%
75.	4.56	Oh	Cincinnati G&E	41.5%
76.	4.55	Mi	Lansing Bd. W&L	41.6%
77.	4.54	SD	Black Hills Corp.	41.6%
78.	4.53	Fl	Tampa Elec.	42.0%
79.	4.49	SD	Northwestern P.S.	42.0%
80.	4.49	Tx	San Antonio PS Bd.	42.4%
81.	4.47	Tx	Houston L&P	45.8%
82.	4.43	Mn	Otter Tail Power	45.9%
83.	4.43	Il	C. Illinois PS	46.2%
84.	4.41	Ky	"Union L, H&P"	46.3%
85.	4.41	WV	Monongahela Power	46.9%
86.	4.40	De	Delmarva P&L	47.3%
87.	4.36	Fl	Gulf Power	47.5%
88.	4.34	Mn	Northern States Power	49.4%
89.	4.34	ND	Northern States Power	49.5%
90.	4.32	Va	Virginia E&P	50.7%
91.	4.27	Ga	Georgia Power	53.9%
92.	4.23	Az	Salt River Project	54.3%
93.	4.23	Co	UtiliCorp United	54.4%
94.	4.19	Tx	Texas Utilies Elec.	57.3%
95.	4.17	In	Indianapolis P&L	58.1%
96.	4.16	In	Northern Indiana P.S.	59.4%
97.	4.16	SC	South Carolina E&G	60.0%
98.	4.16	In	Indiana/Mich. Pwr.	60.8%
99.	4.16	Mo	Union Electric	61.5%
100.	4.15	Tn	Memphis agency	61.7%
101.	4.14	NC	Duke Power Co.	63.8%
102.	4.09	Mo	St. Joseph L&P	63.9%
103.	4.05	La	New Orleans P.S.	64.0%
104.	4.04	Co	Ft. Collins L&P	64.0%
105.	3.97	Ga	Savannah E&P	64.1%
106.	3.96	Mo	Kansas City P&L	64.4%
107.	3.93	NM	Southwestern PS	64.6%
108.	3.93	DC	Potomac Electric	64.6%
109.	3.90	La	C. Louisiana Elec.	64.9%
110.	3.89	Wi	Wisconsin Elec. Power	66.0%
111.	3.88	Co	Colorado Spr. Util.	66.2%
112.	3.88	Ia	Midwest Pwr Sys	66.5%
113.	3.87	Or	PacifiCorp	67.1%
114.	3.87	Or	Portland GE	67.6%
115.	3.85	Il	C. Illinois Light	67.9%
116.	3.84	SC	Duke Power Co.	69.4%
117.	3.83	Ks	Kansas City BPU	69.5%
118.	3.82	WV	Appalachian Power	70.1%
119.	3.81	Mo	City Utilities	70.1%
120.	3.80	Al	Alabama Power	72.7%
121.	3.80	Ne	Lincoln Elec. System	72.7%
122.	3.76	Al	Decatur Utilities	72.8%
123.	3.76	Ne	Grand Island Elec.	72.9%
124.	3.70	Wa	PUD No. 1 Snohomish	73.0%
125.	3.68	Wa	Washington Water Pwr.	73.1%
126.	3.63	Mn	Minnesota P&L	74.0%
127.	3.62	Ut	PacifiCorp	74.8%
128.	3.62	Ia	Iowa-Illinois G&E	75.0%
129.	3.62	Wi	Wisconsin P&L	75.5%
130.	3.61	In	S. Indiana G&E	75.7%
131.	3.59	La	Louisiana P&L	77.7%
132.	3.58	Wy	"Cheyenne L, F&P"	77.7%
133.	3.55	Ky	Louisville G&E	78.1%
134.	3.55	Mt	PacifiCorp	78.1%
135.	3.54	In	PSI Energy	79.3%
136.	3.53	Ms	Mississippi Pwr	79.8%
137.	3.50	Ia	Interstate Power	80.1%
138.	3.48	Ok	PS Oklahoma	80.7%
139.	3.48	Va	Appalachian Power	81.4%
140.	3.43	Tx	Gulf States Utilities	82.2%
141.	3.41	Ar	Southwestern Elec. Pwr.	82.4%
142.	3.41	Ky	Kentucky Utilities	82.9%
143.	3.39	IA	IES Utilities	83.4%
144.	3.38	Tx	Central Power & Light	84.4%
145.	3.37	Wy	PacifiCorp	85.1%
146.	3.37	Wa	Seattle City Light	85.3%
147.	3.36	Mo	Empire District Elec.	85.4%
148.	3.36	Ne	Nebraska PPD	85.5%
149.	3.28	Ne	Omaha PPD	85.7%
150.	3.24	NM	Texas-N.M. Power	85.9%
151.	3.20	Wi	Wisconsin PS	86.3%
152.	3.19	Md	Potomac Edison	86.9%
153.	3.18	Mt	Montana Power	87.3%
154.	3.17	Id	Washington Water Pwr.	87.4%
155.	3.05	SC	SC Public Svc. Auth.	88.1%
156.	3.03	Ok	Oklahoma G&E	88.8%
157.	2.97	Oh	Ohio Power	91.5%
158.	2.97	Ok	Grand River Dam Auth.	91.5%
159.	2.96	Wa	PUD #1 Clark Cty.	91.6%
160.	2.94	Ky	Kentucky Power Co.	92.0%
161.	2.91	Wa	Tacoma DPU	92.4%
162.	2.68	Id	PacifiCorp	92.6%
163.	2.68	Ky	Green River Electric	93.1%
164.	2.66	Or	Bonneville Power Admin	93.5%
165.	2.57	Mt	Bonneville Power Admin	93.8%
166.	2.56	Id	Idaho Power	94.4%
167.	2.55	Wa	Bonneville Power Admin	96.2%
168.	2.06	NY	NY State Power Auth.	96.8%
169.	1.74	Ky	Elec. Energy Inc.	97.8%
170.	1.67	Oh	Ohio Valley Electric	100.0%

These prices represent what electric utilities charged industrial customers in March 1995, based on dividing total revenue by total kwh sold to these customers. These prices may not reflect what individual customers were charged. Prices include demand, power, and fuel adjustment charges. Where possible, special rate programs for large customers have been eliminated to more closely represent actual per kwh costs to most customers. Some utilities make arbitrary one-month adjustments in revenue tallies that do not correspond to what customers were billed. The cumulative kwh percentile tells what percent of the surveyed utilities' total kwh was sold by the individual utility and those above it ranking as more costly. Source: DOE form EIA-826 and ELIN survey.

SECTION 4

SYSTEM SIZING PROCEDURES AND RESULTS

4.1 ICE HARVESTING SYSTEMS

Appendix B contains manufacturer's literature for a typical ice harvesting type of system. Five alternative systems were evaluated, utilizing various combinations of run times vs. off times, and in addition varying the amount of time the systems ran making ice to the amount of time they ran as conventional chillers. The five systems analyzed are summarized in the following table.

ECO#	HOURS MAKING ICE	HOURS AS CHILLER	HOURS "OFF"
IH-1	8	16	0
IH-2	8	10	6
IH-3	12	12	0
IH-4	12	6	6
IH-5	8	13	3

As indicated in a previous section, the ice harvesting system has the ability to continue to produce chilled water during the hours it is in the ice-making mode, due to the fact that the generated ice is de-coupled from the ice-making apparatus. It is therefore available as a separate chilling source. Therefore, the columns labeled as "hours making ice" should not be interpreted as though chilled water cannot be produced during those hours. It simply means that the mechanical refrigeration system will be making ice during those periods.

Each of the indicated ECO's is discussed in the following sections.

4.1.1 ECO IH-1

In this analysis, the system was allowed to build ice during the eight hours of 1:00 a.m. through 9 a.m. inclusive. During the remaining sixteen hours of the day, the plant was allowed to operate as a normal chiller. Applying those parameters to the June to September load profile for Area 600, it was found that an ice storage capacity of 2200 ton-hours coupled with a nominal chiller tonnage of 630 tons (485 tons when making ice) would meet all load conditions and would never totally deplete the tank ice capacity. See Appendix C for the load and demand profile printouts. This results in a relatively low first cost compared to the other alternatives. However, since the refrigeration plant is never "off," demand charges are not avoided, which is the major thrust of the project.

4.1.2 ECO IH-2

In an effort to address the demand changes incurred under ECO IH-1, ECO IH-2 turned the chiller "off" during the mid-afternoon period from noon through 6:00 p.m. All other operational hours remained unchanged from ECO IH-1.

The results of this approach was to drive up significantly the required ice-making capacity of the plant, since stored ice would be all that would be available to carry load during the chiller "off" period. The nominal chiller capacity rose to 1,150 tons (885 tons of ice-making capacity), and ice storage volume of 5,000 ton-hours. Load and demand profiles are contained in Appendix C.

4.1.3 ECO IH-3

This ECO was another variation of ECO IH-1. It was suggested that it might be possible that, in exchange for a longer ice-build time, the size of the chiller needed to supplement the stored ice during the peak afternoon hours might be reduced to the point that the incurred demand charges associated with the chiller might be more economically bearable.

As a result, the ice-build time was expanded to 12 hours, running from 9:00 p.m. through 9:00 a.m. inclusive. From 9:00 a.m. until 9:00 p.m., the system was used to generate chilled water. The resulting load and demand profiles are contained in Appendix C. While extension of the ice build time did result in a smaller chiller requirement, the reduction in size from ECO IH-1 was very slight, from 630 tons to 625 (or from 485 tons of ice-making capacity to 480). As might be expected, the required ice storage capacity increased slightly from 2,200 ton-hours under ECO IH-1 to 2,400 ton-hours under ECO IH-3.

4.1.4 ECO IH-4

This ECO was a modification of ECO IH-3, using the same ice-making hours, but again turning the chiller plant "off" from noon through 6:00 p.m., to avoid demand charges, as was done under ECO IH-2.

The results of this approach were encouraging. Requiring the stored ice to carry the total load during the six afternoon hours drove the ice-making tonnage up from 480 to 750 tons, but the allowance of 12 hours for making ice meant that the 750 tons of capacity was considerably less than the 885 tons that had been required under ECO IH-2. At the same time, the storage capacity required under this ECO was found to be 5,000 ton-hours, which is the same as that required under ECO IH-2.

Again, cooling load and demand profiles for this ECO are contained in Appendix C.

4.1.5 ECO IH-5

A close analysis of the electrical demand profile curve obtained from the electric utility company, referred to in Section 3, indicates that there may be a window of demand establishment as narrow as three hours (from 1:00 p.m. to 4:00 p.m.) during which time an imposition of any additional large refrigeration plant loads on a design day would definitely result in establishment of a new demand peak. Conversely, it appears that the demand loads outside of this hour range fall off steeply enough that powering of the refrigeration plant would not result in establishment of a new demand peak.

Under this hypothesis, an analysis similar to ECO IH-2 was developed, but one in which the chiller was off only from 1:00 p.m. to 4:00 p.m. It was used to build ice between 1:00 a.m. and 9:00 a.m., and would be used as a chiller during the remainder of the day. The results of this approach appeared to be quite promising. The required chiller capacity was reduced to 820 tons from the 1,150 tons needed under ECO IH-2, and the thermal storage capacity was reduced from 5,000 ton-hours to 2,600 ton-hours.

Of course, the value of these numbers is dependant upon the validity of the hypothesis stated above. This approach results is a "fine-tuned" solution to a narrow period of peak demand. The resulting cooling and peak demand load profiles are in Appendix C.

4.2 ICE TANK SYSTEMS

Appendix B contains manufacturer's literature for a typical ice tank type of system. As with the ice harvesting systems, a total of five alternative systems were evaluated with different mixes of chilling, ice-building, and off hours over a 24-hour period. The following table summarizes these combinations:

ECO#	**HOURS MAKING ICE**	**HOURS AS CHILLER**	**HOURS "OFF"**
IT-1	8	16	0
IT-2	11	13	0
IT-3	8	10	6
IT-4	11	7	6
IT-5	11	10	3

Each of the indicated ECO's is discussed in the following sections.

4.2.1 ECO IT-1

In this first analysis, the ice tank was charged during the period from 1:00 a.m. through 9:00 a.m., and was drawn down (supplemented by the refrigeration equipment producing chilled water) during the other hours of the day. There was no period when all equipment was "off." A supplemental chiller was used at night to provide cooling to the Barracks buildings while the main system was building ice.

This scenario resulted in the need for an ice-making capacity of 375 tons (approximately 500 chiller tons) coupled to an ice-tank with a thermal storage capacity of 3,300 ton-hours. In addition, a night chiller with a 400 ton cooling capacity would also be required. While this results in a relatively small total chiller capacity, it is noted that in this option, as in ECO IH-1, there is never an "off" period for the cooling plant, so demand charges are never truly avoided.

Appendix C contains the ice plant loading and demand profiles for the cooling months. It should be noted that this printout does not include the load/demand met by the separate night chiller, since this is independent of the thermal storage plant. Energy usage of the night chiller system is accounted for in energy printouts which will be presented later. This is true for all of the ice tank system alternatives analyzed.

4.2.2 ECO IT-2

ECO IT-2 was developed as a means of reducing the size of the chiller which would need to run during the afternoon hours by having more supplemental ice available by lengthening the ice build time. Therefore, the ice build time period was extended to run from 11:00 p.m. until 10:00 a.m., a total of 11 hours, with the chiller generating chilled water the rest of the time.

As with ECO IH-3, where the same approach was tried, there was some benefit in demand reduction, but not a large one. The chiller tonnage dropped from 500 tons to 450 tons compared to ECO IT-1, which is an ice-making tonnage reduction from 375 tons to 345 tons. However, the ice tank thermal storage volume rose from 3,300 ton-hours to 4,000 ton-hours. Also, the size of the night chiller required rose from 400 tons to 450 tons. See Appendix C for the summer load and demand profiles.

4.2.3 ECO IT-3

This scenario uses the hours from 1:00 a.m. to 9:00 a.m. for ice building and turns all mechanical equipment (except chilled water pumps) off from 12 noon until 6:00 p.m. to avoid adding to peak demands established during that period. During other hours, the refrigeration equipment runs as a conventional chiller.

The requirements for stored ice to serve as the sole means of carrying load over a six-hour period drove up both the size of the thermal storage tank (to 6000 ton-hours) and the ice-making capacity of the refrigeration plant, to 625 tons (approx. 810 tons of normal chilling

capacity). Since the ice-build time was reduced to the same 8 hour period used in ECO IT-1, however, the night chiller's capacity returned to 400 tons, as was the case in ECO IT-1. Appendix C contains the summer load and demand profiles for this case.

4.2.4 ECO IT-4

This alternative assumed that ice will be built over an 11 hour period from 11:00 p.m. until 10:00 a.m., that all systems except chilled water pumps will be off during the period from 12 noon until 6:00 p.m. to avoid demand charges, and that the refrigeration plant will operate as a chiller during all other periods.

The effect of extending the ice build time by 3 hours compared to ECO IT-2 is to reduce the required size of the ice-making capacity of the refrigeration plant since it has a longer time available over which to build the required ice. As a result, the capacity requirement dropped to 490 tons (635 tons chilling capacity) compared to the 625 tons (810 tons chilling) of ice-making capacity required in ECO IT-3. The size of the storage tank remained at 6,000 ton-hours, however. Also, the size of the night chiller required to serve the Barracks buildings increased to 450 tons. Load and demand profiles are presented in Appendix C.

4.2.5 ECO IT-5

As with ECO IH-5, this ECO narrowed the peak demand window to three hours from 1:00 p.m. until 4:00 p.m. Also as with ECO IH-5, the result was a significant improvement over use of a six hour "off" period for the refrigeration plant. The required ice-making tonnage dropped to 400 tons (520 tons chilling capacity) and required total thermal storage was reduced to 4,500 ton-hours. The same caution applies here that was stated in the ECO IH-5 discussion. The results are only valid if total Fort demand is low enough prior to 1:00 p.m. and after 4:00 p.m. See Appendix C for cooling load and demand profiles for this ECO.

4.3 BASE CASE

As stated earlier, a conventional mid-range efficiency centrifugal chiller was used as the base case against which the various ECO's would be compared. The peak load calculated for Area 600 resulted in selection of a chiller with a nominal capacity of 900 tons. Manufacturer's literature for such a typical chiller is included in Appendix B.

4.4 SUMMARY OF RESULTS

The following table summarizes the results presented in the preceding paragraphs, upon which energy calculations were based:

ECO #	REQUIRED ICE-MAKING TONS	EQUIVALENT CHILLER TONS	REQUIRED NIGHT CHILLER CAPACITY	REQUIRED TON-HOURS THERMAL STORAGE
IH-1	485	630	--	2,200
IH-2	885	1,150	--	5,000
IH-3	480	625	--	2,400
IH-4	750	975	--	5,000
IH-5	630	820	--	2,600
IT-1	375	490	400	3,300
IT-2	345	450	450	4,000
IT-3	625	815	400	6,000
IT-4	490	635	450	6,000
IT-5	400	520	450	4,500
BASE	--	900	--	--

SECTION 5

ENERGY AND DEMAND CALCULATIONS

5.1 BASIS OF CALCULATIONS

Individual printouts of each ECO's energy usage (KWH) and component month-by-month peak electrical demand (KW) are contained in Appendix D. Also included therein is the same data for the Base Case of the centrifugal chiller.

The tabulations which follow use this data and data taken from the typical hour-by-hour demand curve for the Fort which was obtained from the utility company to estimate what the electric utility cost difference would be between a given ECO and the Base Case. The electric utility costs incurred are based upon the sum of the energy (KWH) costs and the demand (KW) costs. Each will be explained in turn.

a) Energy (KWH) Costs

Energy costs are simple to determine. The various components in the system each consume energy on a continuing basis. This continuous usage is tallied over a given monthly billing period and the resulting KWH total is then multiplied by the cost per KWH to obtain the energy cost. This procedure is independent of when during the day the energy was used. All usage is figured into the energy cost billed.

b) Demand (KW) Costs

The logic in calculation of demand costs is different. The factor which will determine a demand charge which appears on a monthly statement is the highest KW demand established over the preceding 12 months. This demand is typically established during mid-afternoons of summer months, when air conditioning systems are under peak loads. Therefore, it is very beneficial to minimize or eliminate KW loads during this period.

Therefore, in order to estimate the effect of a given system alternative on total billing demand it was necessary to estimate what the Fort's hourly base demand is during a peak month (taken as July) and then add to that the demands which would be established by that system's cooling plant. The sum of these at each hour is the total peak demand at that hour. The hour with the greatest demand is then taken as establishing the demand which will be billed for the next 12 months.

Using the historical demand curve previously referenced, the following figures were used to estimate base demand for the Fort during a peak day in July:

TIME	DEMAND (KW)
11 AM	26,600
12 NOON	28,000
1 PM	29,100
2 PM	30,000
3 PM	29,000
4 PM	28,400
5 PM	27,700

5.2 BASE CASE PROCEDURES AND RESULTS

Hourly chiller KW demand loads were calculated using a selected machine capacity of 900 tons and applying a part-load efficiency curve to the hourly loads calculated to occur during the design July afternoon period. The chiller was selected to have a peak efficiency of .73 KW per ton, which is a mid-range efficiency selection. Such a selection represents a good value between a high-efficiency chiller and one with a low first cost.

All other system components (pumps, cooling towers), being essentially non-modulating in nature, were taken as establishing their design demand KW throughout the design day afternoon. Energy consumption data were taken directly from the TRACE program output. The following table summarizes this data.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
Centr. Chiller	483	567	541	564	597	659	649
Cooling Tower	72	72	72	72	72	72	72
Cond. Water Pumps	15	15	15	15	15	15	15
Ch. Water Pumps	28	28	28	28	28	28	28
	27,198	28,682	29,756	30,679	29,712	29,174	28,464

Demand in excess of peak: 679 KWD
Demand cost over 12 months: $50,395 (at $6.185 per KWD)

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Total
KWHR usage for:					
Centr. Chiller	358,950	427,172	365,049	284,634	1,435,805

Annual KWHR Cost: $35,895 (at $.025 per KWHR)
Total Annual Utility Cost: $86,290

5.3 ICE HARVESTER SYSTEM ECO'S

The following five sub-sections present the results of demand and energy usage calculations for each ECO, displays the savings in demand and usage between that ECO and the base case, and applies the appropriate KWD and KWHR unit costs to those savings. A resulting annual utility cost savings is shown at the bottom of each tabulation.

It may be noted that one piece of equipment that is listed in the Appendix D energy and demand tabulations is the "Water Circulating Pump-Constant Volume." This pump only runs during the ice-making mode. Therefore, it is off during the hours from 11:00 a.m. to 5:00 p.m.

5.3.1 ECO IH-1

Comments: This system, while producing some demand and energy savings, does not look promising. The total annual savings of $9,485 is rather insignificant.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
630 Ton Chiller	452	461	465	466	467	465	460
Cooling Tower Fans	50	50	50	50	50	50	5050
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pumps	11	11	11	11	11	11	11
	28,141	28,550	29,654	30,555	29,556	28,954	28,249

Peak Demand Reduction Compared to Base Case:	124
Annual demand savings at $6.185 per KWD:	$9,203

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
630 Ton Chiller	350,261	438,155	361,489	274,636	1,424,541
Base case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case	8,689	-10,983	3,560	9,998	11,264

Annual energy savings @ $0.25 per KWHR $282

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $9,485

5.3.2 ECO IH-2

Comments: Significant improvement over ECO IH-1, due to the peak KWD reduction resulting from the chiller, cooling tower, and condenser water pumps being turned off at the peak hour. There is, however, an increase in energy usage due to the size of the ice making chillers and the fact that it takes more energy to make ice than to chill water.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
1,150 Ton Chiller	455	0	0	0	0	0	0
Cooling Tower Fans	92	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	20	0	0	0	0	0	0
	27,195	28,028	29,128	30,028	29,028	28,428	27,728

Peak Demand reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
1,150 Ton Chiller	394,773	493,612	423,914	333,373	1,645,672
Base case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case	-35,823	-66,440	-58,865	-48,739	-209,867

Annual energy savings @ $0.25 per KWHR ($5,247)

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $43,071

5.3.3 ECO IH-3

Comment: This system results in less energy savings than ECO IH-1. More energy is consumed because four hours of operation were shifted to ice-making from water chilling. As noted in the previous paragraph, ice-making uses more energy than water chilling. At the same time, the shift in usage did not produce a meaningful increase in KWD reduction.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
625 Ton Chiller	449	457	461	462	463	462	462
Cooling Tower Fans	50	50	50	50	50	50	50
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	11	11	11	11	11	11	11
	27,138	28,546	29,650	30,551	29,552	28,951	28,251

Peak Demand Reduction Compared to Base Case:	128
Annual Demand Savings at $6.185 per KWD:	$9,500

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
625 Ton Chiller	354,982	460,020	359,978	275,994	1,405,974
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	3,968	-32,848	5,071	8,640	-15,169

Annual Energy Savings at $.025 per KWHR:	($379)
Annual utility cost savings for this ECO:	$9,121

5.3.4 ECO IH-4

Comments: The results of this system compared to ECO IH-2 are very similar to the results of ECO IH-3 compared to ECO IH-1. There is a very small reduction in energy savings which results from shifting four hours of water chilling to ice-building. This is again due to the relative energy inefficiency of ice building, as compared to water chilling. Demand reduction, on the other hand, did not change.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
975 Ton Chiller	454	0	0	0	0	0	0
Cooling Tower Fans	78	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	16	0	0	0	0	0	0
	27,176	28,028	29,128	30,028	29,028	28,028	27,728

Peak Demand Reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
975 Ton Chiller	398,148	505,719	426,572	322,145	1,652,584
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	-39,198	-78,547	-61,523	-37,511	-216,779

Annual Energy Savings at $.025 per KWHR: ($5,419)

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $42,898

5.3.5 ECO IH-5

Comments: As might be expected, the narrowing of the demand "window" during which ice must be available to carry load from six hours to three hours results in the greatest energy savings. This is because less ice-making time at night is needed and, therefore, ice-making inefficiencies are minimized.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
820 Ton Chiller	463	560	0	0	0	606	599
Cooling Tower Fans	66	66	0	0	0	66	66
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	14	14	0	0	0	14	14
	27,171	28,668	29,128	30,028	29,028	29,114	28,407

Peak Demand Reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
820 Ton Chiller	358,977	453,487	379,911	297,877	1,490,252
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	-27	-26,315	-14,862	-13,243	-54,447

Annual Energy Savings at $.025 per KWHR: ($1,361)

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $46,956

5.3.6 SUMMARY TABLE

ECO	Annual Utility Savings Compared to Base Case	
IH-1	$	9,485
IH-2	$	43,071
IH-3	$	9,121
IH-4	$	42,898
IH-5	$	46,956

5.4 ICE TANK SYSTEM ECO'S:

The following sub-sections are arranged in the same manner as those in Section 5.3. Inasmuch as the components associated with the night chiller system only run at night, none of them (the chiller, cooling tower, condenser water pump) are listed in the demand tabulations.

5.4.1 ECO IT-1

Comments: Savings achieved by this system are rather modest, due to the fact that no equipment is turned off during the peak demand period. Demand reduction, though, is better than that achieved by the similar Ice Harvester System IH-1. Annual savings achieved by this ECO amount of $15,200.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
500 Ton Chiller	384	391	394	395	396	395	390
Cooling Tower Fans	41	41	41	41	41	41	41
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	14	14	14	14	14	14	14
	27,067	28,474	29,577	30,478	29,479	28,878	28173

Peak Demand Reduction Compared to Base Case: 201
Annual Demand Savings at $6.185 per KWD: $14,918

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
500 Ton Chiller	350,261	438,155	361,489	274,636	1,424,541
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	8,689	-10,983	3,560	9,998	11,264

Annual Energy Savings at $.025 per KWHR: $282

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $15,200

5.4.2 ECO IT-2

Comments: This shows that shifting the schedule to make more hours available for ice production with the resultant downsizing of the afternoon chiller load does have a beneficial effect. Savings increased from the $15,200 of ECO IT-1 to almost $20,000. Significant peak demand costs, however, are still incurred.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
450 Ton Chiller	346	352	355	356	356	356	351
Cooling Tower Fans	37	37	37	37	37	37	37
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	14	14	14	14	14	14	14
	27,025	28,431	29,534	30,435	29,435	28,835	28,130

Peak Demand Reduction Compared to Base Case: 244
Annual Demand Savings at $6.185 per KWD: $18,110

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
450 Ton Chiller	328,168	426,614	350,686	256,216	1,361,684
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	30,782	558	14,363	28,418	74,121

Annual Energy Savings at $.025 per KWHR: $1,853

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $19,963

5.4.3 ECO IT-3

Comments: This option clearly demonstrates the importance of eliminating all peak demands. In turning off the chilling plant during the projected peak demand hours, annual energy savings jumped from the $15,200 figure of ECO IT-1 to almost $49,000.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
810 Ton Chiller	496	0	0	0	0	0	0
Cooling Tower Fans	66	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	20	0	0	0	0	0	0
	27,210	28,028	29,128	30,028	29,028	28,428	27728

Peak Demand Reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
810 Ton Chiller	336,084	435,802	366,197	288,333	1,426,416
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	22,866	-8,630	-1,148	-3,699	9,389

Annual Energy Savings at $.025 per KWHR: $235

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $48,552

5.4.4 ECO IT-4

Comments: This option of keeping the same amount of afternoon off hours while lengthening the amount of time during which ice could be made showed a very marginal improvement in savings over ECO IT-3. Annual savings increased by less than $1,000, to roughly $49,400.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
635 Ton Chiller	456	0	0	0	0	0	0
Cooling Tower Fans	51	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	17	0	0	0	0	0	0
	27,152	28,028	29,128	30,028	29,028	28,428	27,728

Peak Demand Reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
635 Ton Chiller	328,844	430,629	358,020	276,736	1,394,229
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	30,106	-3,457	7,029	7,898	41,576

Annual Energy Savings at $.025 per KWHR: $1,039

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $49,357

5.4.5 ECO IT-5

Comments: As might be expected, the "best case" approach of being able to shut down all systems only during three hours in the afternoon allowed the best annual savings to be achieved, approaching $50,000.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
520 Ton Chiller	399	407	0	0	0	411	406
Cooling Tower Fans	42	42	0	0	0	42	42
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	16	16	0	0	0	16	16
	27,085	28,493	29,128	30,028	29,028	28,897	28,192

Peak Demand Reduction Compared to Base Case:	651
Annual Demand Savings at $6.185 per KWD:	$48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
520 Ton Chiller	330,432	430,572	355,477	269,063	1,385,544
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	28,518	-3,400	9,572	15,571	50,261

Annual Energy Savings at $.025 per KWHR:	$1,257
TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO:	$49,574

SECTION 6

COST ESTIMATES, LCC PRINTOUTS, AND RESULTS

Appendix E contains the conceptual cost estimates for each of the ECO's and the Base Case. Equipment sizes were determined from the cooling load calculations and costs were obtained from sales engineers representing manufacturers. Installation costs were taken from the 1995 Means Estimating Guides, and allowances were made for associated materials such as piping and insulation. In addition, costs were factored in for associated work and burdens such as controls, balancing, and project manuals and start-up. Markup rates of 10% for overhead and profit and 15% for contingencies were added to estimate totals.

The LCCID program approaches this type of project by comparing ECO costs to ECO savings. As a result, since this is in effect a replacement project, data was entered for each of the ECO's by entering the difference in construction costs between the ECO and the Base Case as the ECO cost, and the utility cost difference between the ECO and the Base Case as the ECO savings. An economic life of 20 years was used for the analysis.

Utility costs entered were taken directly from the ICO utility cost summaries tabulated in Section 5. No meaningful non-energy recurring or non-recurring costs are anticipated that would be distinguishable between any of the ECO's and the Base Case.

The resulting LCC Analysis Summaries for the 10 ECO's are presented on the following pages, and are summarized below:

ECO	Total Investment*	Total Discounted Savings	Simple Payback Period (Yrs)	SIR	Adjusted I.R.R.
IH-1	$ 948,394	$ 141,412	99.99	.15	-6.35
IH-2	2,231,477	635,640	51.81	.28	-3.27
IH-3	938,656	135,338	102.91	.14	-6.51
IH-4	1,174,666	632,896	27.38	.54	-.14
IH-5	1,067,969	697,342	22.74	.65	.83
IT-1	536,849	226,452	35.32	.42	-1.35
IT-2	648,009	298,903	32.46	.46	-.91
IT-3	1,048,431	722,684	21.59	.69	1.10
IT-4	968,714	735,463	19.63	.76	1.59
IT-5	759,010	738,911	15.31	.97	2.86

*Compared to Base Case

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-1
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 769817.		
B. SIOH	$ 85406.		
C. DESIGN COST	$ 93171.		
D. TOTAL COST (1A+1B+1C)	$ 948394.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 948394.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	11.	$ 282.	15.88	$ 4472.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 9203.	14.88	$ 136941.
N. TOTAL		11.	$ 9485.		$ 141412.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 9485.

5. SIMPLE PAYBACK PERIOD (1G/4) 99.99 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 141412.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .15
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -6.35 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-2
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 1920564.
B. SIOH $ 148698.
C. DESIGN COST $ 162215.
D. TOTAL COST (1A+1B+1C) $ 2231477.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 2231477.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-210.	$ -5247.	15.88	$ -83317.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		-210.	$ 43070.		$ 635640.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 43070.

5. SIMPLE PAYBACK PERIOD (1G/4) 51.81 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 635640.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .28
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -3.27 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-3
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 761083.
B. SIOH $ 84926.
C. DESIGN COST $ 92647.
D. TOTAL COST (1A+1B+1C) $ 938656.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 938656.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-15.	$ -379.	15.88	$ -6022.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 9500.	14.88	$ 141360.
N. TOTAL		-15.	$ 9121.		$ 135338.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 9121.

5. SIMPLE PAYBACK PERIOD (1G/4) 102.91 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 135338.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .14
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -6.51 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017   COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996   DISCRETE PORTION NAME: ECO IH-4
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 972958.
B. SIOH $ 96469.
C. DESIGN COST $ 105239.
D. TOTAL COST (1A+1B+1C) $ 1174666.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 1174666.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-217.	$ -5419.	15.88	$ -86061.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		-217.	$ 42898.		$ 632896.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 42898.

5. SIMPLE PAYBACK PERIOD (1G/4) 27.38 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 632896.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .54
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -.14 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-5
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 877121.		
B. SIOH	$ 91275.		
C. DESIGN COST	$ 99573.		
D. TOTAL COST (1A+1B+1C)	$ 1067969.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1067969.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-54.	$ -1361.	15.88	$ -21615.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		-54.	$ 46956.		$ 697342.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 46956.

5. SIMPLE PAYBACK PERIOD (1G/4) 22.74 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 697342.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .65
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): .83 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017   COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996   DISCRETE PORTION NAME: ECO IT-1
ANALYSIS DATE: 08-21-95   ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 400815.
B. SIOH $ 65060.
C. DESIGN COST $ 70974.
D. TOTAL COST (1A+1B+1C) $ 536849.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 536849.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	11.	$ 282.	15.88	$ 4472.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 14918.	14.88	$ 221980.
N. TOTAL		11.	$ 15200.		$ 226452.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 15200.

5. SIMPLE PAYBACK PERIOD (1G/4) 35.32 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 226452.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .42
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -1.35 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-2
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 500510.
B. SIOH $ 70543.
C. DESIGN COST $ 76956.
D. TOTAL COST (1A+1B+1C) $ 648009.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 648009.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	74.	$ 1853.	15.88	$ 29426.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 18110.	14.88	$ 269477.
N. TOTAL		74.	$ 19963.		$ 298903.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 19963.

5. SIMPLE PAYBACK PERIOD (1G/4) 32.46 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 298903.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .46
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -.91 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-3
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 859365.	
B. SIOH	$ 90423.	
C. DESIGN COST	$ 98643.	
D. TOTAL COST (1A+1B+1C)	$ 1048431.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 1048431.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	9.	$ 235.	15.88	$ 3727.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		9.	$ 48552.		$ 722684.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 48552.

5. SIMPLE PAYBACK PERIOD (1G/4) 21.59 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 722684.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .69
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 1.10 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017   COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996   DISCRETE PORTION NAME: ECO IT-4
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 787991.		
B. SIOH	$ 86433.		
C. DESIGN COST	$ 94290.		
D. TOTAL COST (1A+1B+1C)	$ 968714.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 968714.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	42.	$ 1039.	15.88	$ 16506.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		42.	$ 49356.		$ 735463.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 49356.

5. SIMPLE PAYBACK PERIOD (1G/4) 19.63 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 735463.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .76
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 1.59 %

LIFE CYCLE COST ANALYSIS SUMMARY　　STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)　　LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-5
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 599942.		
B. SIOH	$ 76076.		
C. DESIGN COST	$ 82992.		
D. TOTAL COST (1A+1B+1C)	$ 759010.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 759010.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	50.	$ 1257.	15.88	$ 19954.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		50.	$ 49574.		$ 738911.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)　　$ 0.
(1) DISCOUNT FACTOR (TABLE A)　　14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1)　　$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 49574.

5. SIMPLE PAYBACK PERIOD (1G/4)　　15.31 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)　　$ 738911.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)=　　.97
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):　　2.86 %

As can be seen, none of the ECO's meet the required SIR hurdle of 1.25, including the "optimized" cases. The conclusion is that cold thermal storage is a non-feasible approach to reducing utility costs at Fort Leonard Wood. The reasons for this are very basic.

First, cold thermal storage systems are extremely expensive to install, compared to conventional chilled water generators such as centrifugal chillers. The difference in first costs can be amortized over a reasonable period of time, but only if demand and energy charges avoided are high, such as exist on the east coast of the United States. However, the rates being charged at Fort Leonard Wood are among the lowest in the country. The accompanying table, from the 7/95 issue of Energy User News, reflects this. It shows that, at the current rate of 2.50 cents per KWHR, had Ft. Leonard Wood's utility company been included in this list it would have been one of the cheapest rates in the country, ranking in the top 2.5% of those listed. While this table reflects energy charges only, it is generally the case that energy rates and demand rates go hand-in-hand. Such systems can also be made feasible if the local utility has financing or cash contribution incentives which can be applied against first costs. However, the local utility has no such programs available.

A contributing factor which hurts the viability of cold thermal storage is the need to have cooling available at night for the Barracks buildings. Most cold thermal storage systems are successfully employed only on buildings which have a regular "down time" such as office buildings, which are closed at nights and over weekends. Such downtime allows the ice system to devote itself exclusively to re-charging of the ice tanks, without the need to simultaneously provide cooling. Such a need for concurrent cooling drives the installed cost of the system up very significantly.

RANKING OF ELECTRICITY PRICES — INDUSTRIAL

Rank	Cts/kwh	State	UTILITY	Cum kwh
1.	12.71	Hi	Hawaii Elec. Light	0.0%
2.	11.20	NY	Consolidated Edison	0.1%
3.	10.86	Hi	Maui Electric	0.2%
4.	9.98	NH	P.S. New Hampshire	0.4%
5.	9.82	Ma	Commonwealth Elec.	0.4%
6.	9.21	RI	Blackstone Valley Elec.	0.5%
7.	8.87	Ct	United Illum.	0.6%
8.	8.78	Hi	Hawaiian Electric	1.0%
9.	8.51	Ma	W. Massachusetts Elec.	1.1%
10.	8.49	NJ	Jersey Central P&L	1.6%
11.	8.46	Ma	Boston Edison	1.8%
12.	8.30	NJ	Atlantic City Electric	1.9%
13.	8.21	Ca	Los Angeles Dept W&P	2.6%
14.	8.21	Me	Central Maine Power	3.1%
15.	7.80	NJ	Public Service E&G	4.2%
16.	7.64	Ct	Connecticut L&P	4.7%
17.	7.63	RI	Narragansett Elec.	4.8%
18.	7.51	Pa	Peco Energy	6.8%
19.	7.42	Me	Bangor Hydroelectric	6.9%
20.	7.12	NY	Orange/Rockland Utils.	7.0%
21.	6.64	CA	Sacramento MUD	7.5%
22.	6.51	Ca	S. Calif. Edison	10.2%
23.	6.41	Vt	Central Vermont P.S.	10.3%
24.	6.38	Az	Tucson Elec. Power	10.7%
25.	6.32	Oh	Cleveland Elec. Illum.	11.6%
26.	6.20	Ca	San Diego G&E	12.0%
27.	6.17	Ca	Pacific G&E	14.5%
28.	6.15	Ma	Massachusetts Elec.	15.0%
29.	6.10	Il	Commonwealth Edison	17.9%
30.	5.85	Oh	Ohio Edison	19.2%
31.	5.84	Pa	Duquesne Light	19.6%
32.	5.71	Ak	Golden Valley Elec.	19.6%
33.	5.58	Md	Delmarva P&L	19.6%
34.	5.53	Ms	Mississippi P&L	20.0%
35.	5.50	Mi	Detroit Edison	21.8%
36.	5.45	Ar	Arkansas P&L	22.5%
37.	5.43	Vt	Green Mountain Power	22.6%
38.	5.40	Pa	Pennsylvania P&L	23.8%
39.	5.38	Mi	Consumers Power	25.4%
40.	5.35	Nv	Sierra Pacific Power	25.8%
41.	5.31	NM	PS New Mexico	25.8%
42.	5.29	Az	Arizona PS	26.4%
43.	5.18	Ga	Cobb Electric	26.4%
44.	5.07	NY	Niagara Mohawk Pwr.	27.9%
45.	5.06	NY	Central Hudson G&E	28.0%
46.	5.05	NC	Fayetteville PW	28.1%
47.	5.04	NC	Carolina P&L	29.5%
48.	5.02	Md	Baltimore Gas & Elec.	31.1%
49.	5.00	Fl	Florida Power	31.5%
50.	4.98	Tn	Volunteer Elec Coop	31.5%
51.	4.94	WV	Potomac Edison	31.6%
52.	4.92	Ks	Kansas City P&L	31.7%
53.	4.91	Fl	Florida P&L	32.1%
54.	4.89	Al	Huntsville agency	32.3%
55.	4.88	Oh	Columbus S. Power	32.7%
56.	4.87	Tn	Nashville Elec. Svc.	33.4%
57.	4.86	Ks	Western Resources	34.1%
58.	4.85	ND	MDU Resources	34.1%
59.	4.85	SC	Carolina P&L	34.5%
60.	4.85	Tn	Knoxville Agency	34.8%
61.	4.80	Wa	Puget Sound P&L	35.3%
62.	4.79	Ga	Jackson Elec.	35.4%
63.	4.79	Il	Illinois Power	36.4%
64.	4.77	Nv	Nevada Power	36.9%
65.	4.70	Pa	West Penn Power	37.9%
66.	4.69	NC	Virginia E&P	38.1%
67.	4.66	Mi	Indiana/Mich. Pwr.	38.2%
68.	4.64	Md	Potomac Electric	38.2%
69.	4.61	ND	Otter Tail Power	38.3%
70.	4.59	Tx	Austin agency	38.4%
71.	4.59	La	Gulf States Utilities	39.4%
72.	4.58	Tn	Chattanooga agency	39.8%
73.	4.57	Co	PS Colorado	40.5%
74.	4.57	Wi	Northern States Power	40.8%
75.	4.56	Oh	Cincinnati G&E	41.5%
76.	4.55	Mi	Lansing Bd. W&L	41.6%
77.	4.54	SD	Black Hills Corp.	41.6%
78.	4.53	Fl	Tampa Elec.	42.0%
79.	4.49	SD	Northwestern P.S.	42.0%
80.	4.49	Tx	San Antonio PS Bd.	42.4%
81.	4.47	Tx	Houston L&P	45.8%
82.	4.43	Mn	Otter Tail Power	45.9%
83.	4.43	Il	C. Illinois PS	46.2%
84.	4.41	Ky	"Union L, H&P"	46.3%
85.	4.41	WV	Monongahela Power	46.9%
86.	4.40	De	Delmarva P&L	47.3%
87.	4.36	Fl	Gulf Power	47.5%
88.	4.34	Mn	Northern States Power	49.4%
89.	4.34	ND	Northern States Power	49.5%
90.	4.32	Va	Virginia E&P	50.7%
91.	4.27	Ga	Georgia Power	53.9%
92.	4.23	Az	Salt River Project	54.3%
93.	4.23	Co	UtiliCorp United	54.4%
94.	4.19	Tx	Texas Utilies Elec.	57.3%
95.	4.17	In	Indianapolis P&L	58.1%
96.	4.16	In	Northern Indiana P.S.	59.4%
97.	4.16	SC	South Carolina E&G	60.0%
98.	4.16	In	Indiana/Mich. Pwr.	60.8%
99.	4.16	Mo	Union Electric	61.5%
100.	4.15	Tn	Memphis agency	61.7%
101.	4.14	NC	Duke Power Co.	63.8%
102.	4.09	Mo	St. Joseph L&P	63.9%
103.	4.05	La	New Orleans P.S.	64.0%
104.	4.04	Co	Ft. Collins L&P	64.0%
105.	3.97	Ga	Savannah E&P	64.1%
106.	3.96	Mo	Kansas City P&L	64.4%
107.	3.93	NM	Southwestern PS	64.6%
108.	3.93	DC	Potomac Electric	64.6%
109.	3.90	La	C. Louisiana Elec.	64.9%
110.	3.89	Wi	Wisconsin Elec. Power	66.0%
111.	3.88	Co	Colorado Spr. Util.	66.2%
112.	3.88	Ia	Midwest Pwr Sys	66.5%
113.	3.87	Or	PacifiCorp	67.1%
114.	3.87	Or	Portland GE	67.6%
115.	3.85	Il	C. Illinois Light	67.9%
116.	3.84	SC	Duke Power Co.	69.4%
117.	3.83	Ks	Kansas City BPU	69.5%
118.	3.82	WV	Appalachian Power	70.1%
119.	3.81	Mo	City Utilities	70.1%
120.	3.80	Al	Alabama Power	72.7%
121.	3.80	Ne	Lincoln Elec. System	72.7%
122.	3.76	Al	Decatur Utilities	72.8%
123.	3.76	Ne	Grand Island Elec.	72.9%
124.	3.70	Wa	PUD No. 1 Snohomish	73.0%
125.	3.68	Wa	Washington Water Pwr.	73.1%
126.	3.63	Mn	Minnesota P&L	74.0%
127.	3.62	Ut	PacifiCorp	74.8%
128.	3.62	Ia	Iowa-Illinois G&E	75.0%
129.	3.62	Wi	Wisconsin P&L	75.5%
130.	3.61	In	S. Indiana G&E	75.7%
131.	3.59	La	Louisiana P&L	77.7%
132.	3.58	Wy	"Cheyenne L, F&P"	77.7%
133.	3.55	Ky	Louisville G&E	78.1%
134.	3.55	Mt	PacifiCorp	78.1%
135.	3.54	In	PSI Energy	79.3%
136.	3.53	Ms	Mississippi Pwr	79.8%
137.	3.50	Ia	Interstate Power	80.1%
138.	3.48	Ok	PS Oklahoma	80.7%
139.	3.48	Va	Appalachian Power	81.4%
140.	3.43	Tx	Gulf States Utilities	82.2%
141.	3.41	Ar	Southwestern Elec. Pwr.	82.4%
142.	3.41	Ky	Kentucky Utilities	82.9%
143.	3.39	IA	IES Utilities	83.4%
144.	3.38	Tx	Central Power & Light	84.4%
145.	3.37	Wy	PacifiCorp	85.1%
146.	3.37	Wa	Seattle City Light	85.3%
147.	3.36	Mo	Empire District Elec.	85.4%
148.	3.36	Ne	Nebraska PPD	85.5%
149.	3.28	Ne	Omaha PPD	85.7%
150.	3.24	NM	Texas-N.M. Power	85.9%
151.	3.20	Wi	Wisconsin PS	86.3%
152.	3.19	Md	Potomac Edison	86.9%
153.	3.18	Mt	Montana Power	87.3%
154.	3.17	Id	Washington Water Pwr.	87.4%
155.	3.05	SC	SC Public Svc. Auth.	88.1%
156.	3.03	Ok	Oklahoma G&E	88.8%
157.	2.97	Oh	Ohio Power	91.5%
158.	2.97	Ok	Grand River Dam Auth.	91.5%
159.	2.96	Wa	PUD #1 Clark Cty.	91.6%
160.	2.94	Ky	Kentucky Power Co.	92.0%
161.	2.91	Wa	Tacoma DPU	92.4%
162.	2.68	Id	PacifiCorp	92.6%
163.	2.68	Ky	Green River Electric	93.1%
164.	2.66	Or	Bonneville Power Admin	93.5%
165.	2.57	Mt	Bonneville Power Admin	93.8%
166.	2.56	Id	Idaho Power	94.4%
167.	2.55	Wa	Bonneville Power Admin	96.2%
168.	2.06	NY	NY State Power Auth.	96.8%
169.	1.74	Ky	Elec. Energy Inc.	97.8%
170.	1.67	Oh	Ohio Valley Electric	100.0%

These prices represent what electric utilities charged industrial customers in March 1995, based on dividing total revenue by total kwh sold to these customers. These prices may not reflect what individual customers were charged. Prices include demand, power, and fuel adjustment charges. Where possible, special rate programs for large customers have been eliminated to more closely represent actual per kwh costs to most customers. Some utilities make arbitrary one-month adjustments in revenue tallies that do not correspond to what customers were billed. The cumulative kwh percentile tells what percent of the surveyed utilities' total kwh was sold by the individual utility and those above it ranking as more costly. Source: DOE form EIA-826 and EUN survey.

COE
LIMITED ENERGY STUDY
THERMAL STORAGE AT
CENTRAL CHILLED WATER PLANT
FORT LEONARD WOOD, MISSOURI
930073-0017

May 31, 1996

APPENDIX

END OF APPENDIX

APPENDIX A

SCOPE OF WORK

MRK-ED-MF

3 MAY 1994
REVISED 11 JULY 1994
REVISED 25 AUGUST 1994

GENERAL SCOPE OF WORK
FOR A
LIMITED ENERGY STUDY
THERMAL STORAGE AT
CENTRAL CHILLED WATER PLANT
FORT LEONARD WOOD, MISSOURI

Performed as part of the

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

1. <u>BRIEF DESCRIPTION OF WORK</u>: The Architect-Engineer (AE) shall:

1.1 Review the previously completed Energy Engineering Analysis Program (EEAP) study which applies to the specific building, system, or energy conservation opportunity (ECO) covered by this study.

1.2 Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.

1.3 Reevaluate the specific project or ECO from the previous study to determine its economic feasibility based on revised criteria, current site conditions and technical applicability.

1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

1.5 Provide project documentation for recommended ECOs as detailed herein.

1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. <u>GENERAL</u>

2.1 This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.

2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.

2.3 For the buildings, systems or ECOs listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.

2.4 The study shall consider the use of all energy sources applicable to each building, system, or ECO.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAIM-FDF-U, dated 10 January 1994 establishes criteria for ECIP projects and shall be used

for performing the economic analyses of <u>all</u> ECOs and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer.

2.6 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The rquirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month. The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the AE desires to use a different program, it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP, MCA, or PCIP funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.

2.7.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.7.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

2.7.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP,

however, ECAM is also meant.

3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the installation will designate an individual to assist the AE in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification

number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of P(ublic Works before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Public Works.

3.7.2 Exit. The exit interview shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Public Works.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, supervision and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities which the AE has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $300,000, a Savings to Investment Ratio greater than 1.25 and a simple payback period of less than ten years. For ECAM projects, the $300,000 limitation may not apply; in such cases, the AE shall check with the installation for guidance. The overall project and each discrete part of the project shall have an SIR greater than one. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented), and a Project Development Brochure (PDB). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate, payback period, or non-energy (75%) qualification test, but which have an SIR greater than one shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.7.2 and shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA, ie, energy savings calculations and cost estimate(s), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

b. O & M Energy Projects. An O & M Energy project is one that results in needed maintenance or repair to an existing facility, or replaces a failed or failing existing facility, and also results in energy savings. The criteria are similar to the criteria for ECIP projects, i.e. $300,000 construction cost, SIR > 1.25, and simple payback period of less than ten years. In addion, if the project would replace a sytem or equipment that is considered failed or failing" due soley to obsolete technology or inefficiency, the equipment to be replaced must have been in u for at least three years; and the simple payback period must be three years or less.

c. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,000 and a simple payback period of four to twenty-five years. Documentation shall consist of DD Form 1391 and a Project

Development Brochure.

d. Low Cost/No Cost Projects. These are projects which the Director of Engineering and Housing (DEH) can perform using his resources. Documentation shall be as required by the DEH.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. Review the previous EEAP study which applies to the specific building, system, or ECO covered by this study. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the ECOs in this study may be contained in the previous study.

7.2 Perform a Limited Site Survey. The AE shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3 Reevaluate Selected Projects. The AE shall reevaluate the projects and ECOs listed in Annex A. These are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall ~~then~~ be analyzed ~~based on~~ current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings, the energy costs and construction costs shall be updated, and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the

report.

7.4 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph [7.6.1], the AE will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per par [7.6.2].

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The AE shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer

to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

a.All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b.All ECOs which were analysed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and AE's representatives shall coordinate with the Director of Public Works to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Final Submittal. The AE shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The AE shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph [7.6.1] shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged

to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

1) Energy cost development and backup data

2) Detailed calculations

3) Cost estimates

4) Computer printouts (where applicable)

5) Scope of Work

ANNEX A

DETAILED SCOPE OF WORK

1. LOCATION

a. GENERAL DESCRIPTION. The Architect Engineer (AE) shall furnish all services, materials, supplies, labor, equipment, investigations, studies, and travel as required in connection with the feasibility study for the below identified project in accordance with the contract and all furnished instructions:

INSTALLATION	DESCRIPTION
Fort Leonard Wood, Missouri	Providing Thermal Storage at Central Chilled Water Plant

b. The project consists of studying the feasibility of providing thermal at the central chilled water plant, building 745, to reduce electric peak demand charges. The Plant now has two chillers providing water to the 600 area. There are plans to expand this system to the 700 area. This will require adding more chillers, either expanding the plant or converting the space currently occupied by 5 boilers to new chillers. This study will determine if it is ecconomically feasible to provide thermal storage to reduce the electrical demand.

2. AUTHORIZATION. The feasibility study for this project is authorized by Memorandum CEMP-ET, Subject: Energy Engineering Analysis Program (EEAP)-FY94 dated 7 December 1993. The AE shall make reference to this authority in the study.

3. STUDY INSTRUCTIONS. If the Design Manuals, Guide Specifications, and/or Project Engineering Instructions do not cover a specific condition in question, the AE shall contact the Contracting Officer before proceeding. If there is a conflict in Engineering Instructions or other reference data, such questions or conflicts should be brought to the attention of the Contracting Officer before proceeding.

4. THE INSTALLATION REPRESENTATIVE for this contract will be Mr. Douglas Cage, Directorate of Public Works, telephone number 314-596-0940, fax number 314-596-0170. The Kansas City Project Manager will be Mr. Robert Miller, telephone number 816-426-7348, fax number 816-426-3690. The Authorized Representative of the Contracting Officer will be Mr. Michael Whitacre, telephone number 816-426-2781, fax number 816-426-3690..

5. COMPLETION AND PAYMENT SCHEDULE: The following schedule shall be used as a guide in approving payments on this contract. The interim report for shall be due not later than 180

days after Notice to Proceed. The prefinal report shall be due not later than 30 days after the interim report review conference. The final report shall be due not later than 21 days after the prefinal review conference.

MILESTONE	PERCENT OF CONTRACT AMOUNT AUTHORIZED FOR PAYMENT
Entry Interview	10
Completion of Field Work	25
Receipt of Interim Submittal	75
Completion of Interim Presentation & Review	85

6. METHOD OF PAYMENT.

a. Title I. The AE shall prepare and submit to the US Army Engineer District, Kansas City, partial payment estimates in accordance with the attachment entitled "Instructions for Completion of ENG Form 93." All partial payments shall be based on work completed as of the 15th day of the report month and shall be submitted to the office of the Contracting Officer by the 18th day of the month. Payment under this contract, for which property or services are provided in a series of partial executions or deliveries, will be made within 30 days after receipt of an invoice which has been properly executed by the AE.

b. Additional Conferences. Payment for furnishing the services of technically qualified representatives to attend additional conferences, when so requested in writing by the Contracting Officer, will be made at a rate per hour for the discipline involved plus travel expenses computed in accordance with Government Joint Travel Regulations in effect at the time travel is performed and actual cost of transportation.

7. THE SIMULATION PROGRAMS acceptable for use in this study are listed below. Any substitutes must be submitted and approved as outlined in the basic scope of work.

a. Building Loads and System Thermodynamics (BLAST)

b. DOE 2.1B

c. Carrier E20 or Hourly Analysis Program (HAP)

d. Trane Air-Conditioning Economics (TRACE)

e. Beacon

8. A COMPUTER PROGRAM titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. This computer program can be used for performing the economic calculations for ECIP and non-ECIP ECOs. The AE is encouraged to obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. Telephone number is (217) 333-3977 or (800) 842-5278.

9. FACILITY SURVEY

The Architect-Engineer (AE) shall conduct a survey of the boiler plant and buildings to be supplied by the summer boiler.

10. AUTOMATED REVIEW MANAGEMENT SYSTEM (ARMS).

a. The AE, as a part of this scope of work, shall interface with and utilize the Corps of Engineers Automated Review Management System for this project. The AE will receive one copy of CESPK-PAM 1110-1-2, AE Response Package (User's Manual) describing the communications software, optimum hardware requirements and access procedures. The necessary software is included with the manual. Minimum requirements are an IBM-XT or compatible computer system running DOS 3.0 or later, with 640 kilobyte (KB) RAM, at least a 20 megabyte (MB) hard disk and a 1200 or higher baud Hayes-compatible modem operating. Assistance can be received via a telephone hotline at 916-551-3126.

b. All design review comments and responses will be electronically transmitted from the Corps of Engineer, Missouri River Division, by the ARMS. Comments can be received at a personal computer in the AE's office by use of ARMS software and a modem over telephone lines. The comments reside on the Missouri River Division computer. The AE can then download the review comments, respond to the comments, upload the comments back to the Division computer and forward responses to the Project Manager.

11. GOVERNMENT-FURNISHED DATA.

a. AR 415-15 Military Construction, Army (MCA) Program Developement

b. AR 415-20 Project Development and Design Approval

d. Engineering Instructions (as applicable)

e. Latest Tri-Service Cost Index.

f. DAIM-FDF-U letter dated 10 January 1994, "Energy Conservation Investment Program (ECIP) Guidance".

12. SUBMITTAL REQUIREMENTS.

ORGANIZATION	COPIES REQUIRED (Correspondence);	Interim & Prefinal Review	(Final)
Commander Engineer Center & FSort Leonard Wood ATTN: ATZT-DPW-EO/Mr. Cage Building 2104 Granite City, Illinois 62040-1801	(1)	3***	(3)
District Engineer U.S. Army Engineer District, Kansas City ATTN: CEMRKED-MF(MILLER) 700 Federal Building Kansas City, Missouri 64106	(1)	3***	(3)
Division Engineer U.S.Army Engineer Division Missouri River ATTN: CEMRDMP-A(Jagasits) 12565 W. Center Road Omaha, NE 68144-3869	(1)	3***	(1)
Commander H.Q. TRADOC ATTEN: ATEN-EN/ Mr. Capra Building 10 Fort Monroe, Va. 23351	(1)	1	(1)
HQDA ODCSLOG ATTN: DALO-TSE (Maj. Wilson) Pentagon Washington, D.C. 20310-0561			(1)*
Commander U.S. Army Corps of Engineers ATTN: CEMP-ET (Mr. Gentil) 20 Massachusetts Avenue, NW Washington, DC 20314-1000		1*	(1)*

Commander U.S. Army Engineer District, Mobile ATTN: CESAM-EN-CM (Mr. Battaglia) P.O. Box 2288 Mobile, AL 36628-1000	(1)	1	(1)
Commander U.S Army Logistics Evaluation Agency ATTN: LOEA-PL (Mr. Keath) New Cumberland Army Depot New Cunberland, PA. 17070-5007			(1)*

* Executive Summary only

** Complete copy of final report

*** Furnish copy of computer print out

ANNEX B

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Building Data (types, number of similar buildings, sizes, etc.)

3. Present Energy Consumption of Buildings or Systems Studied.

   o Total Annual Energy Used.

   o Source Energy Consumption.

Electricity	- KWH, Dollars, BTU
Fuel Oil	- GALS, Dollars, BTU
Natural Gas	- THERMS, Dollars, BTU
Propane	- GALS, Dollars, BTU
Other	- QTY, Dollars, BTU

4. Reevaluated Projects Results.

5. Energy Conservation Analysis.

   o ECOs Investigated.

   o ECOs Recommended.

   o ECOs Rejected. (Provide economics or reasons)

   o ECIP Projects Developed. (Provide list)*

   o Non-ECIP Projects Developed. (Provide list)*

   o Operational or Policy Change Recommendations.

   * Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.

6. Energy and Cost Savings.

   o Total Potential Energy and Cost Savings.

   o Percentage of Energy Conserved.

- Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

a. In title block clearly identify projects as "ECIP."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.).

d. List references, and assumptions, and provide calculations to support dollar and energy savings, and indicate any added costs.

(1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage, floor area, window and wall area for each exposure.

(2) Identify weather data source.

(3) Identify infiltration assumptions before and after improvements.

(4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.

g. An ECIP life cycle cost analysis summary sheet as shown in the ECIP Guidance shall be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.

i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.

j. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable and (3) an economic analysis supporting the specific retrofit.

k. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

l. Any requirements required by ECIP guidance dated 25 April 1988 and any revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.

m. The five digit category number for all ECIP projects except for Family Housing is 80000. The category code number for Family Housing projects is 71100.

APPENDIX B

DETAILED SYSTEM SIZING PROCEDURES AND CALCULATIONS

B.1 ICE HARVESTING SYSTEMS

Appendix C contains manufacturer's literature for a typical ice harvesting type of system. Five alternative systems were evaluated, utilizing various combinations of run times vs. off times, and in addition varying the amount of time the systems ran making ice to the amount of time they ran as conventional chillers. The five systems analyzed are summarized in the following table.

ECO#	HOURS MAKING ICE	HOURS AS CHILLER	HOURS "OFF"
IH-1	8	16	0
IH-2	8	10	6
IH-3	12	12	0
IH-4	12	6	6
IH-5	8	13	3

As indicated in a previous section, the ice harvesting system has the ability to continue to produce chilled water during the hours it is in the ice-making mode, due to the fact that the generated ice is de-coupled from the ice-making apparatus. It is therefore available as a separate chilling source. Therefore, the columns labeled as "hours making ice" should not be interpreted as though chilled water cannot be produced during those hours. It simply means that the mechanical refrigeration system will be making ice during those periods.

Each of the indicated ECO's is discussed in the following sections.

B.1.1 ECO IH-1

In this analysis, the system was allowed to build ice during the eight hours of 1:00 a.m. through 9 a.m. inclusive. During the remaining sixteen hours of the day, the plant was allowed to operate as a normal chiller. Applying those parameters to the June to September load profile for Area 600, it was found that an ice storage capacity of 2200 ton-hours coupled with a nominal chiller tonnage of 630 tons (485 tons when making ice) would meet all load conditions and would never totally deplete the tank ice capacity. See Appendix D for the load and demand profile printouts. This results in a relatively low first cost compared to the other alternatives. However, since the refrigeration plant is never "off," demand charges are not avoided, which is the major thrust of the project.

B.1.2 ECO IH-2

In an effort to address the demand changes incurred under ECO IH-1, ECO IH-2 turned the chiller "off" during the mid-afternoon period from noon through 6:00 p.m. All other operational hours remained unchanged from ECO IH-1.

The results of this approach was to drive up significantly the required ice-making capacity of the plant, since stored ice would be all that would be available to carry load during the chiller "off" period. The nominal chiller capacity rose to 1,150 tons (885 tons of ice-making capacity), and ice storage volume of 5,000 ton-hours. Load and demand profiles are contained in Appendix D.

B.1.3 ECO IH-3

This ECO was another variation of ECO IH-1. It was suggested that it might be possible that, in exchange for a longer ice-build time, the size of the chiller needed to supplement the stored ice during the peak afternoon hours might be reduced to the point that the incurred demand charges associated with the chiller might be more economically bearable.

As a result, the ice-build time was expanded to 12 hours, running from 9:00 p.m. through 9:00 a.m. inclusive. From 9:00 a.m. until 9:00 p.m., the system was used to generate chilled water. The resulting load and demand profiles are contained in Appendix D. While extension of the ice build time did result in a smaller chiller requirement, the reduction in size from ECO IH-1 was very slight, from 630 tons to 625 (or from 485 tons of ice-making capacity to 480). As might be expected, the required ice storage capacity increased slightly from 2,200 ton-hours under ECO IH-1 to 2,400 ton-hours under ECO IH-3.

B.1.4 ECO IH-4

This ECO was a modification of ECO IH-3, using the same ice-making hours, but again turning the chiller plant "off" from noon through 6:00 p.m., to avoid demand charges, as was done under ECO IH-2.

The results of this approach were encouraging. Requiring the stored ice to carry the total load during the six afternoon hours drove the ice-making tonnage up from 480 to 750 tons, but the allowance of 12 hours for making ice meant that the 750 tons of capacity was considerably less than the 885 tons that had been required under ECO IH-2. At the same time, the storage capacity required under this ECO was found to be 5,000 ton-hours, which is the same as that required under ECO IH-2.

Again, cooling load and demand profiles for this ECO are contained in Appendix D.

B.1.5 ECO IH-5

A close analysis of the electrical demand profile curve obtained from the electric utility company, referred to in Section 3, indicates that there may be a window of demand establishment as narrow as three hours (from 1:00 p.m. to 4:00 p.m.) during which time an imposition of any additional large refrigeration plant loads on a design day would definitely result in establishment of a new demand peak. Conversely, it appears that the demand loads outside of this hour range fall off steeply enough that powering of the refrigeration plant would not result in establishment of a new demand peak.

Under this hypothesis, an analysis similar to ECO IH-2 was developed, but one in which the chiller was off only from 1:00 p.m. to 4:00 p.m. It was used to build ice between 1:00 a.m. and 9:00 a.m., and would be used as a chiller during the remainder of the day. The results of this approach appeared to be quite promising. The required chiller capacity was reduced to 820 tons from the 1,150 tons needed under ECO IH-2, and the thermal storage capacity was reduced from 5,000 ton-hours to 2,600 ton-hours.

Of course, the value of these numbers is dependant upon the validity of the hypothesis stated above. This approach results is a "fine-tuned" solution to a narrow period of peak demand. The resulting cooling and peak demand load profiles are in Appendix D.

B.2 ICE TANK SYSTEMS

Appendix C contains manufacturer's literature for a typical ice tank type of system. As with the ice harvesting systems, a total of five alternative systems were evaluated with different mixes of chilling, ice-building, and off hours over a 24-hour period. The following table summarizes these combinations:

ECO#	HOURS MAKING ICE	HOURS AS CHILLER	HOURS "OFF"
IT-1	8	16	0
IT-2	11	13	0
IT-3	8	10	6
IT-4	11	7	6
IT-5	11	10	3

Each of the indicated ECO's is discussed in the following sections.

B.2.1 ECO IT-1

In this first analysis, the ice tank was charged during the period from 1:00 a.m. through 9:00 a.m., and was drawn down (supplemented by the refrigeration equipment producing chilled water) during the other hours of the day. There was no period when all

equipment was "off." A supplemental chiller was used at night to provide cooling to the Barracks buildings while the main system was building ice.

This scenario resulted in the need for an ice-making capacity of 375 tons (approximately 500 chiller tons) coupled to an ice-tank with a thermal storage capacity of 3,300 ton-hours. In addition, a night chiller with a 400 ton cooling capacity would also be required. While this results in a relatively small total chiller capacity, it is noted that in this option, as in ECO IH-1, there is never an "off" period for the cooling plant, so demand charges are never truly avoided.

Appendix D contains the ice plant loading and demand profiles for the cooling months. It should be noted that this printout does not include the load/demand met by the separate night chiller, since this is independent of the thermal storage plant. Energy usage of the night chiller system is accounted for in energy printouts which are contained in Appendix E. This is true for all of the ice tank system alternatives analyzed.

B.2.2 ECO IT-2

ECO IT-2 was developed as a means of reducing the size of the chiller which would need to run during the afternoon hours by having more supplemental ice available by lengthening the ice build time. Therefore, the ice build time period was extended to run from 11:00 p.m. until 10:00 a.m., a total of 11 hours, with the chiller generating chilled water the rest of the time.

As with ECO IH-3, where the same approach was tried, there was some benefit in demand reduction, but not a large one. The chiller tonnage dropped from 500 tons to 450 tons compared to ECO IT-1, which is an ice-making tonnage reduction from 375 tons to 345 tons. However, the ice tank thermal storage volume rose from 3,300 ton-hours to 4,000 ton-hours. Also, the size of the night chiller required rose from 400 tons to 450 tons. See Appendix D for the summer load and demand profiles.

B.2.3 ECO IT-3

This scenario uses the hours from 1:00 a.m. to 9:00 a.m. for ice building and turns all mechanical equipment (except chilled water pumps) off from 12 noon until 6:00 p.m. to avoid adding to peak demands established during that period. During other hours, the refrigeration equipment runs as a conventional chiller.

The requirements for stored ice to serve as the sole means of carrying load over a six-hour period drove up both the size of the thermal storage tank (to 6000 ton-hours) and the ice-making capacity of the refrigeration plant, to 625 tons (approx. 810 tons of normal chilling capacity). Since the ice-build time was reduced to the same 8 hour period used in ECO IT-1, however, the night chiller's capacity returned to 400 tons, as was the case in ECO IT-1. Appendix D contains the summer load and demand profiles for this case.

B.2.4 ECO IT-4

This alternative assumed that ice will be built over an 11 hour period from 11:00 p.m. until 10:00 a.m., that all systems except chilled water pumps will be off during the period from 12 noon until 6:00 p.m. to avoid demand charges, and that the refrigeration plant will operate as a chiller during all other periods.

The effect of extending the ice build time by 3 hours compared to ECO IT-2 is to reduce the required size of the ice-making capacity of the refrigeration plant since it has a longer time available over which to build the required ice. As a result, the capacity requirement dropped to 490 tons (635 tons chilling capacity) compared to the 625 tons (810 tons chilling) of ice-making capacity required in ECO IT-3. The size of the storage tank remained at 6,000 ton-hours, however. Also, the size of the night chiller required to serve the Barracks buildings increased to 450 tons. Load and demand profiles are presented in Appendix D.

B.2.5 ECO IT-5

As with ECO IH-5, this ECO narrowed the peak demand window to three hours from 1:00 p.m. until 4:00 p.m. Also as with ECO IH-5, the result was a significant improvement over use of a six hour "off" period for the refrigeration plant. The required ice-making tonnage dropped to 400 tons (520 tons chilling capacity) and required total thermal storage was reduced to 4,500 ton-hours. The same caution applies here that was stated in the ECO IH-5 discussion. The results are only valid if total Fort demand is low enough prior to 1:00 p.m. and after 4:00 p.m. See Appendix D for cooling load and demand profiles for this ECO.

B.3 BASE CASE

As stated earlier, a conventional mid-range efficiency centrifugal chiller was used as the base case against which the various ECO's would be compared. The peak load calculated for Area 600 resulted in selection of a chiller with a nominal capacity of 900 tons. Manufacturer's literature for such a typical chiller is included in Appendix C.

B.4 SUMMARY OF CALCUALTIONS

The following table summarizes the data presented in the preceding paragraphs, upon which energy calculations were based:

ECO #	REQUIRED ICE-MAKING TONS	EQUIVALENT CHILLER TONS	REQUIRED NIGHT CHILLER CAPACITY	REQUIRED TON-HOURS THERMAL STORAGE
IH-1	485	630	--	2,200
IH-2	885	1,150	--	5,000
IH-3	480	625	--	2,400
IH-4	750	975	--	5,000
IH-5	630	820	--	2,600
IT-1	375	490	400	3,300
IT-2	345	450	450	4,000
IT-3	625	815	400	6,000
IT-4	490	635	450	6,000
IT-5	400	520	450	4,500
BASE	--	900	--	--

APPENDIX C

MANUFACTURER'S LITERATURE

Only Turbo Ice Harvesting gives you the flexibility for operating as many hours as you want.

Turbo: A leadership company in a corporate family of Industry leaders.

Turbo Refrigerating Company was founded in 1952 to provide specialized ice making and industrial refrigeration systems.

Turbo pioneered itself as the leading world supplier of this technology, having built over 70% of the industrial ice harvesting capacity for consumer packaged ice.

Today Turbo is the world leader in ice harvesting Thermal Storage Systems and industrial chillers.

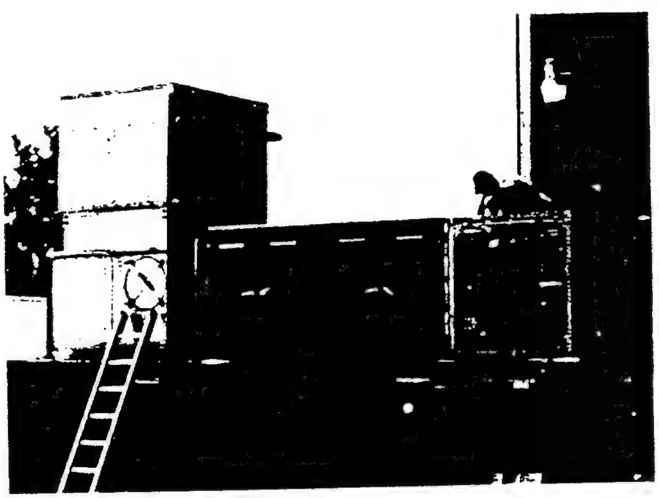
Turbo is a member of the Aqua-Chem family of companies – each a recognized leader in its specialized field:

***Cleaver-Brooks** – Originator and largest producer of packaged boilers for industrial, commercial, and institutional use.*

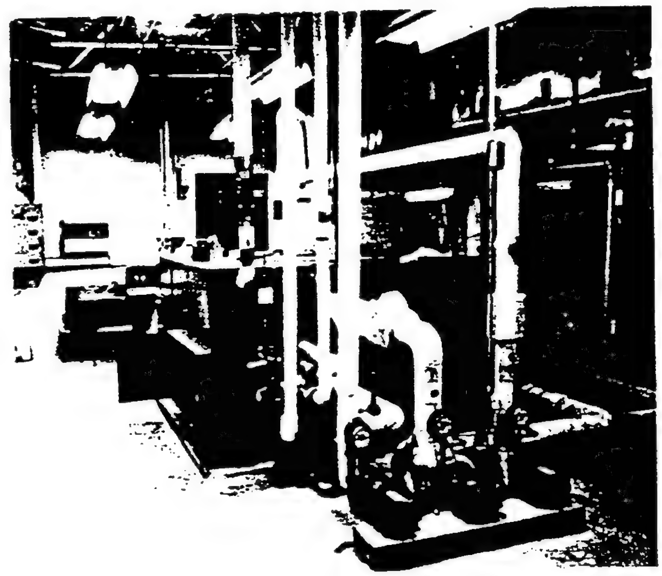
***Water Technologies Division** – World leader in water evaporative and desalination equipment for chemical processing and marine application.*

***Industrial Combustion** – Foremost manufacturer of multi-fuel conversion burners for new and retrofit industrial and commercial applications.*

Aqua-Chem companies are deeply involved in energy and water technologies, and are committed to continuing advancements in product efficiency and reliability.



HP300SCE – A fully self-contained ice generator chiller with an evaporative condenser system



HP100SC – A fully self-contained ice generator chiller with a water cooled condenser system.

Unlike other thermal storage systems, the Turbo ice harvesting design uses an ice-making surface that is completely separate from the ice storage tank. The ice-making surface consists of stainless steel plates that are welded together to form computer-designed internal channels for controlled flow of refrigerant. Water is distributed uniformly over the outside of the plates. The plates are grouped vertically in modules directly above the ice storage tank. Ice forms on both sides in sheets ¼ inch thick. Then, at predetermined intervals, hot refrigerant enters the plates, causing the ice to break away and drop into the tank. The ice breaks into small pieces in the tank.

The cycle is repeated as long as there is need for additional cooling reserves. Turbo ice gives a tremendous amount of heat transfer area, allowing very rapid melting with no risk of short circuiting of the return chilled water.

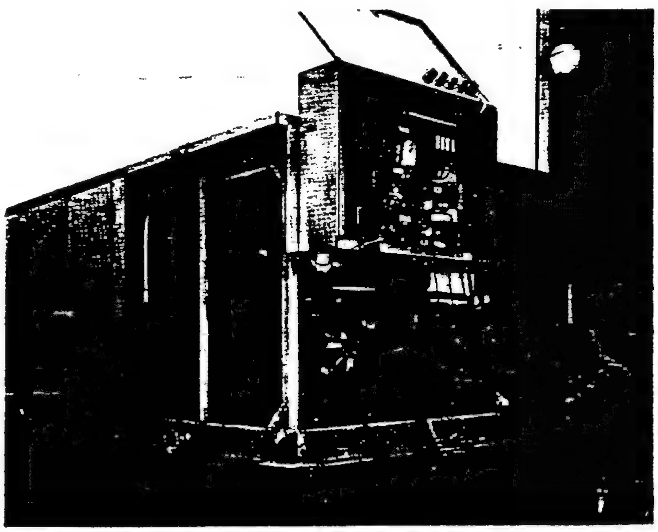
This continuous ice making capability is impossible with systems where heat transfer coils are submerged in ice storage tanks – because the ice making surfaces become encased in ice, insulating the heat transfer surface and reducing the efficiency of the system, while waiting for a thaw before production can resume.

Nothing could be simpler than inspecting, cleaning or servicing Turbo heat transfer plates. They're always accessible – because they're completely separated from ice storage. Open the front or rear panel of the ice maker cabinet – and there they are!

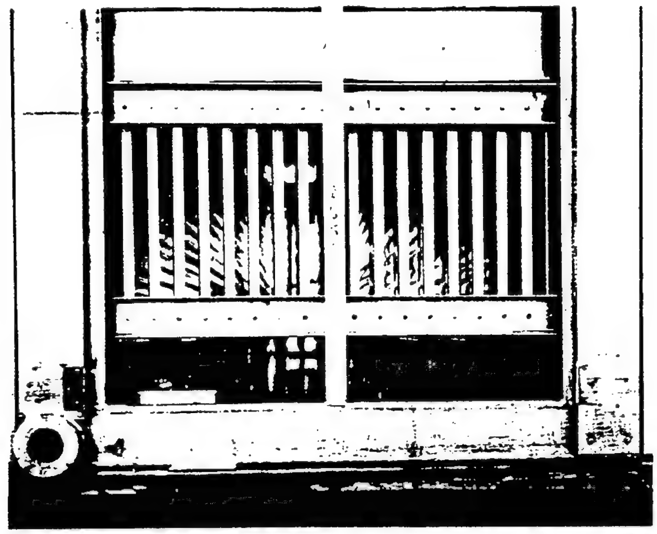
All operating components, controls easily accessible.

Talk about convenience! Electrical controls, compressor, condenser – all maintenance components are located for easy access that simplifies inspection and servicing.

Only Turbo supplies complete single-source systems: packaged or modular, standard or custom.



HP1000SCER – The compressor compartment showing the ease of accessibility.



The evaporator plate assembly.

Large units can be factory-assembled, tested before delivery.

Only Turbo meets your requirements totally and precisely, whatever the level of need. Which means you don't pay for too much compressor, too much capacity or too much storage for your system needs. Turbo delivers a system of fully compatible components, engineered for maximum cost effectiveness. An advantage that covers thermal storage capacities much larger than available with alternative approaches.

The standard Turbo package is a self-contained or split unitary system. Ice-making plates, refrigerant piping, condensers and controls are provided in a proven reliable package.

Options Available:

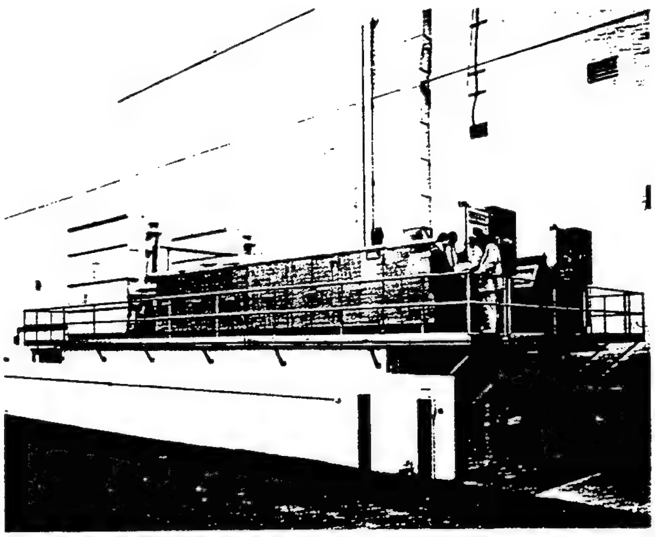
- Choice of air-cooled, water-cooled or evaporatively cooled condensers
- Desuperheaters and controls for heat recovery
- Electrical panel for remote stand-alone installations.
- Recirculation pump package
- Ice-storage-tank – prefabricated or custom designed, field erected

HP Series Packages – to 95 tons

Proven design. Available as self-contained package without field refrigerant piping. Shippable by standard truck with no special permits required. Available in water cooled (SC), evaporatively cooled (SCE), or air cooled models (SCA).

IGC Series Packages – 55 to 300 tons

Proven design. Available as self-contained package without field refrigerant piping. Shippable by standard trucks. Available in water cooled (SC), evaporatively cooled (SCE), or air cooled (SCA) models.



HP1000SCE – Two units with two 4000 cubic foot Turbo insulated steel storage tanks.

Standard Split System Packages

Remote condenser models available for air cooled or evaporatively cooled systems. In both the HP and IGC SERIES. (SC R).

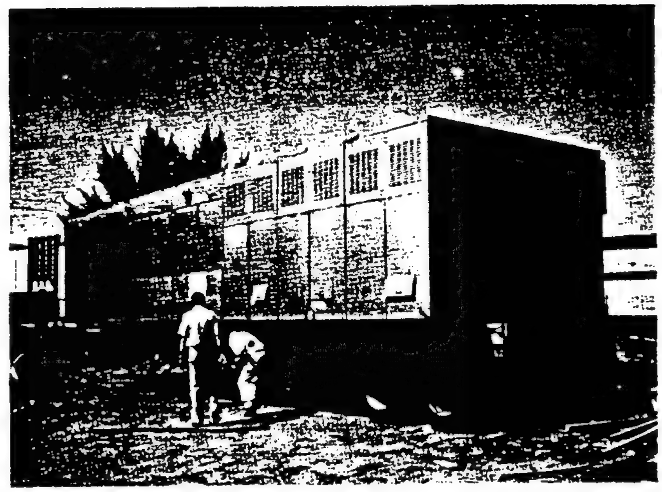
Remote condensing unit models available for connection to existing or Turbo condensing units. (R)

To 300 tons

Larger systems require separate plate, compressor and condenser modules. Plate modules available to 300 tons capacity per module. Modules bolt together in the field, and require minimum field refrigerant piping.

Custom Engineered Systems

Our engineers will work closely with you to meet special needs for larger or unique applications using standard modules



IGC245SC – A fully self-contained water cooled-ice generator chiller unit.

IGC245SC – Control panels

[illegible]

HP200SCE – A complete packaged system with an HP200SCE, evaporative condenser and insulated steel storage tank.

EQUIPMENT SCHEDULE: MODEL (HP ______) (IGC ______)

Operating Mode	Water onto plates (F)	net cap tons	sct (F)	motor BHP
Ice Generation	____	____	____	____
Super Chiller	____	____	____	____

EQUIPMENT:

The ice making equipment shall be a completely factory assembled unit of the harvesting type provided by TURBO REFRIGERATING COMPANY. The equipment shall have the following features.

Evaporater sections

The evaporater section shall utilize vertical evaporater plates made of 304 stainless steel.

Water distribution

The equipment shall have a stainless steel water distribution pan and be provided with all water distribution piping.

Frames

The frames (HP) shall be fully welded and hot dip galvanized after fabrication.

The frames (IGC) shall be fully welded and coated with a rust preventative primer and water proof finish.

Cabinets

The cabinets shall be insulated with 2" of foam urethane and suitable for outdoor application. The outer panels shall be protected with an approved exterior finish.

Compressor

The compressor shall be of the open (semi-hermetic) reciprocating type complete with motor and starter, or screw compressor with motor or starter.

Condensers

The condenser shall be of the evaporative type, (water cooled), (air cooled).

Refrigerant piping

The refrigerant piping shall utilize direct expansion valves, hot gas harvesting valves and a suction line accumulator with integral liquid suction interchanger, receiver designed to hold entire refrigerant charge. All vessels shall be constructed in accordance with the ASME Pressure Vessel Code.

Controls

Controls shall be electric or electronic and include all ice harvesting controls, water level controls, and refrigeration controls.

TESTING:

All system components are operationally checked before shipping.

Full factory run tests are available upon request.

TURBO

ICE SYSTEMS · LIQUID CHILLERS · THERMAL STORAGE

TURBO REFRIGERATING COMPANY
PO BOX 396
DENTON, TX 7620[illegible]
81[illegible] 387 4301
TELEX 68[illegible] TURBO [illegible]
FAX 817 382 0364

A new application of an old idea that can cut air conditioning energy costs in half.

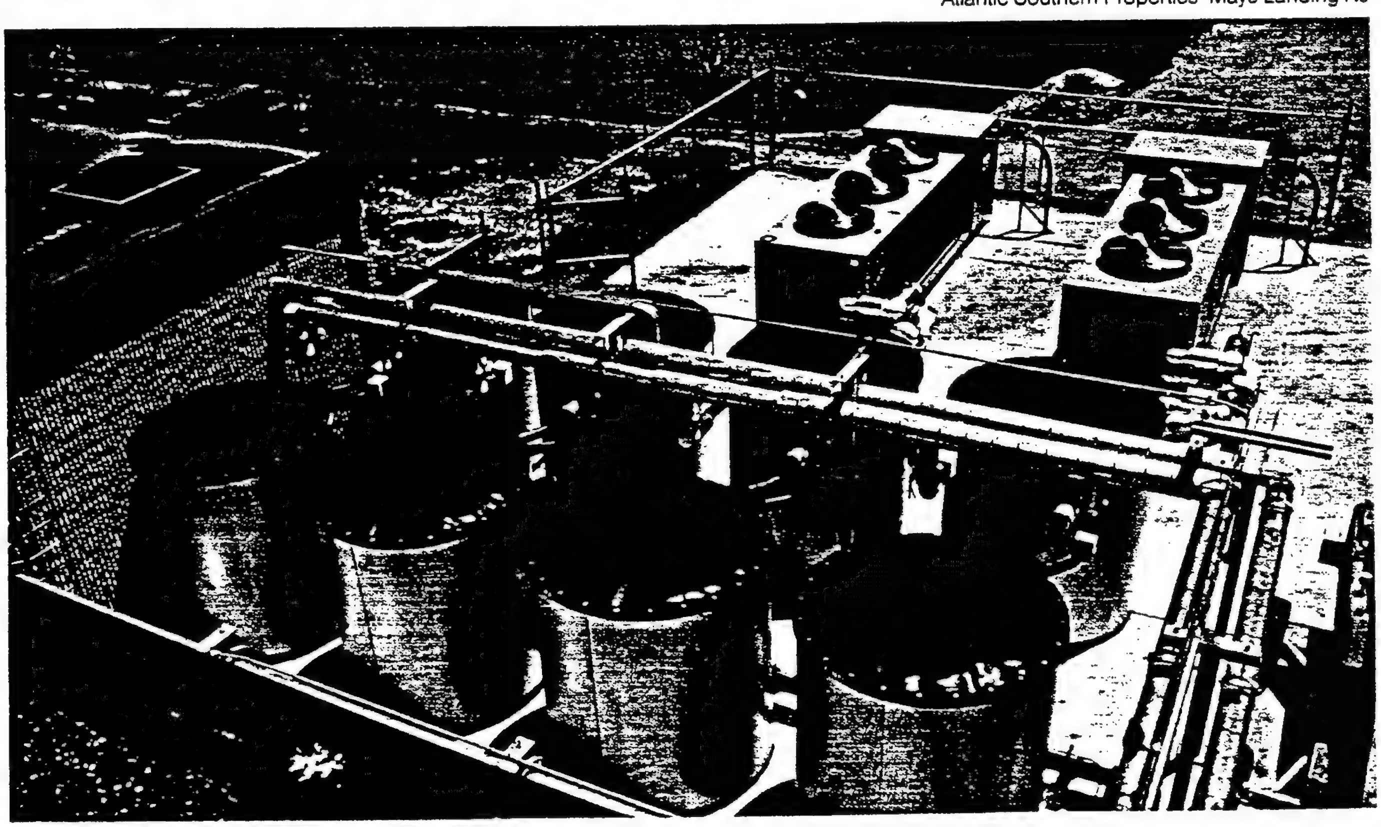
Air conditioning during summer daytime hours is the largest single contributor to utility "peak demand" charges. After noon, as more air conditioners are needed to maintain comfortable temperatures, the increased demand for electricity adds to that already created by lighting, operating equipment, computers and thousands of other uses. This requires the utility to bring additional, more costly generating sources on line to handle its increased demand. Commercial users whose large air conditioning loads contribute to these added generating requirements are assessed an additional charge based on their highest on-peak demand for electricity.

An Ice Bank Stored Cooling System is either a load-shifting or load-leveling method which will significantly lower demand charges during the air conditioning season and, consequently, energy costs. It uses a standard packaged chiller to produce solid ice at night during off-peak periods when the building's electrical needs are at a minimum. The ice is built and stored in modular ice tanks to provide cooling to help meet the building's air conditioning load requirement the following day.

Making ice at night and using its stored energy during the day is not a new or experimental idea. This concept had been employed for years in cooling short-peak applications such as churches and theatres. However, longer peak uses were served by air-source rooftop and chiller-type air conditioners which were less costly to install. Now there is renewed interest in a broad use of ice-making systems by both users and utilities as the best way to offset rising operating costs. In fact, Stored Cooling Systems are what summer-peaking utilities *must have* to avoid the unbearable costs of new generating plants.

Ice Banks not only can cut operating costs in half but they can also substantially reduce capital outlays when systems are suitably designed for new commercial and industrial buildings. Engineers can specify half-size chillers operating 24 hours a day rather than full-size chillers operating only 10 or 12 hours per day. In retrofit applications, an Ice Bank Stored Cooling System can often provide cooling for an addition to a building without adding chiller capacity.

Atlantic Southern Properties Mays Landing NJ



How the LEVLOAD System Works

The LEVLOAD Ice Bank is a modular, insulated polyethylene tank containing a spiral-wound plastic tube heat exchanger surrounded with water. They are available in four sizes – 90, 100, 190 and 570 ton-hours. At night, a 75 percent water-25 percent glycol solution from a standard packaged air conditioning chiller circulates through the heat exchanger and extracts heat until eventually all the water in the tank is frozen solid. The ice is built uniformly throughout the tank by the patented temperature-averaging effect of closely spaced counterflow heat exchanger tubes, Figure 5. Water does not become surrounded by ice during the freezing process and can move freely as ice forms, preventing stress or damage to the tank.

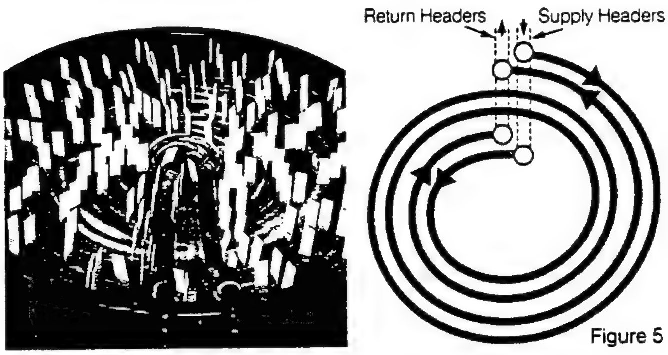


Figure 5

Typical flow diagrams for a Partial Storage System are shown in Figures 6 and 7.

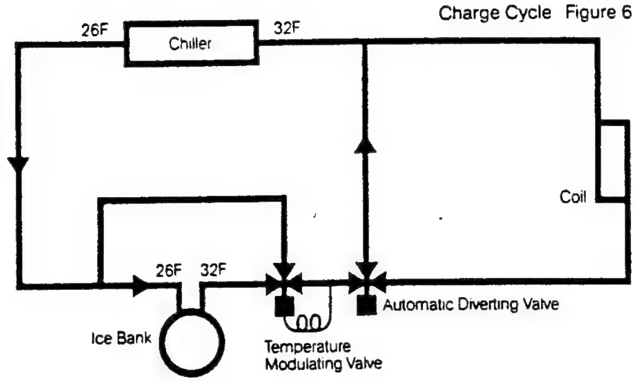
At night, the water-glycol solution circulates through the chiller and the Ice Bank heat exchanger, bypassing the air handler coil. The fluid is at 26F and freezes the water surrounding the heat exchanger.

During the day, the solution is cooled by the Ice Bank from 52F to 34F. A temperature modulating valve set at 44F in a bypass loop around the Ice Bank permits a sufficient quantity of 52F fluid to bypass the Ice Bank, mix with the 34F fluid, and achieve the desired 44F temperature. The 44F fluid enters the coil, where it cools air from 75F to 55F. The fluid leaves the coil at 60F, enters the chiller and is cooled to 52F.

It should be noted that, while making ice at night, the chiller must cool the water-glycol solution to 26F, rather than produce 44 or 45F water temperatures required for conventional air conditioning systems. This has the effect of "derating" the nominal chiller capacity by approximately 30 percent. Compressor efficiency, however, is only slightly reduced because lower nighttime temperatures result in cooler condenser water from the cooling tower and help keep the unit operating efficiently. Similarly, air cooled chillers benefit from cooler condenser entering air temperatures at night.

The temperature modulating valve in the bypass loop has the added advantage of providing unlimited capacity control. During many mild temperature days in the spring and fall, the chiller will be capable of providing all the necessary cooling for the building without assistance from stored cooling. When the building's actual cooling load is equal to or lower than the chiller capacity, all of the system coolant flows through the bypass loop, as in Figure 8.

Charge Cycle Figure 6



Discharge Cycle Figure 7

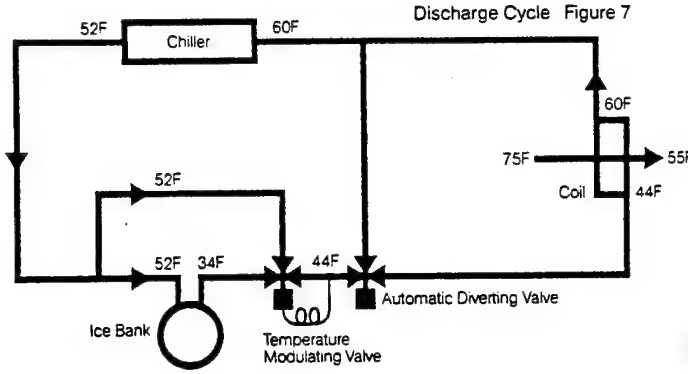
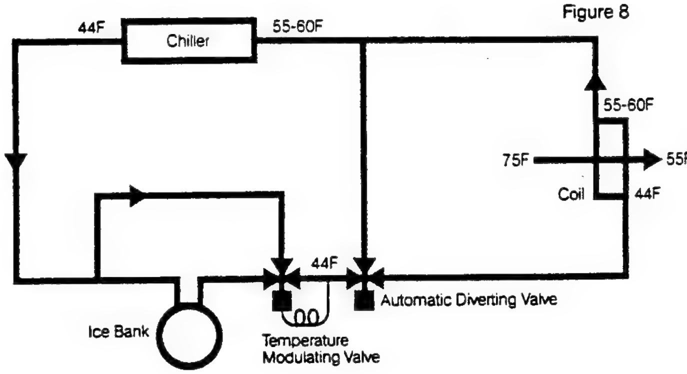


Figure 8



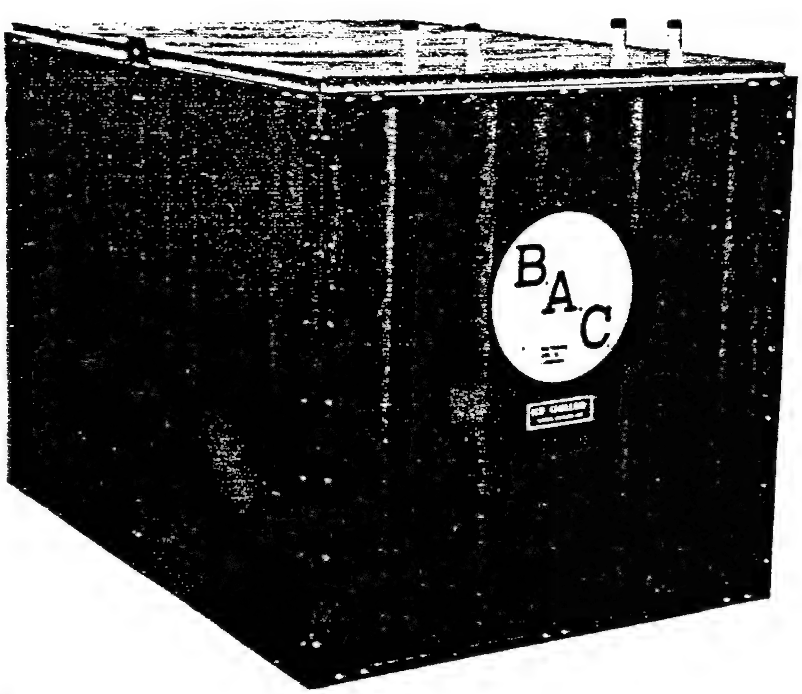
The glycol recommended for the solution is an ethylene glycol-based industrial coolant, such as Dow Chemical Company's Dowtherm® SR-1 or Union Carbide Corporation's UCARTHERM,® which are specially formulated for low viscosity and superior heat transfer properties. These contain a multi-component corrosion inhibitor system which is effective with most materials of construction, including aluminum, copper, solder and plastics. Unlike automotive-type anti-freeze, they produce no films and contain no anti-leak agents to interfere with heat transfer efficiency and permit use of standard system pumps, seals and air handler coils. However, because of the slight difference in heat transfer coefficient between water-glycol and plain water, coil capacity should be increased by approximately 5 percent. It is also important that the water and glycol be thoroughly mixed before the solution enters the system.

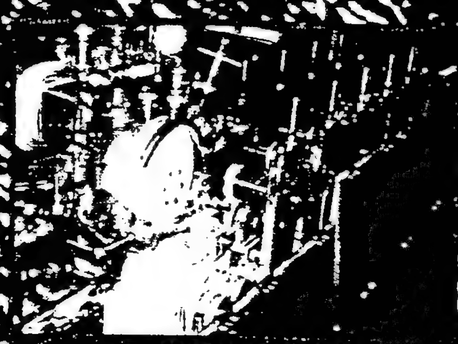
ETHYLENE GLYCOL

An industrially inhibited ethylene glycol solution specifically designed for HVAC applications must be used with the ICE CHILLER® Thermal Storage Unit. The 25% by weight ethylene glycol solution is designed to provide freeze/burst and corrosion protection. Corrosion inhibitors are provided to minimize system corrosion without fouling. Dowtherm® SR-1* and UCARTHERM®** are acceptable fluids.

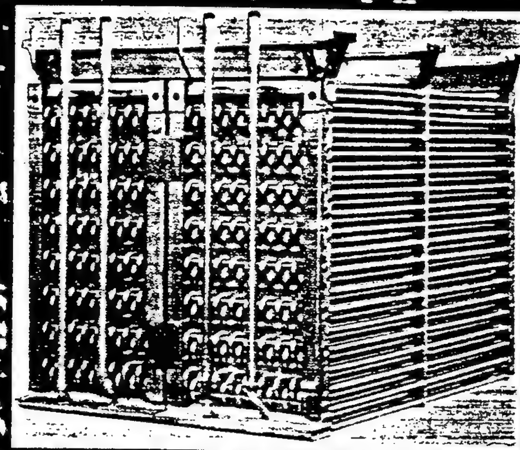
MODULAR CONSTRUCTION

The rectangular design of these units maximizes the ton-hours per square foot of available plan area. The product is designed specifically for tight installations where access is limited. The 7'-10" wide units are designed so that they can be installed through interior double-door openings. For applications where extreme access limitations exist, the tanks are available unassembled for field erection. Units can be installed either indoors or outdoors.





Coil Fabrication



Galvanized Steel Coil

Structural Steel Channels

Coils Installed In The Tank

* Dowtherm® is a registered trademark of Dow Chemical Company.

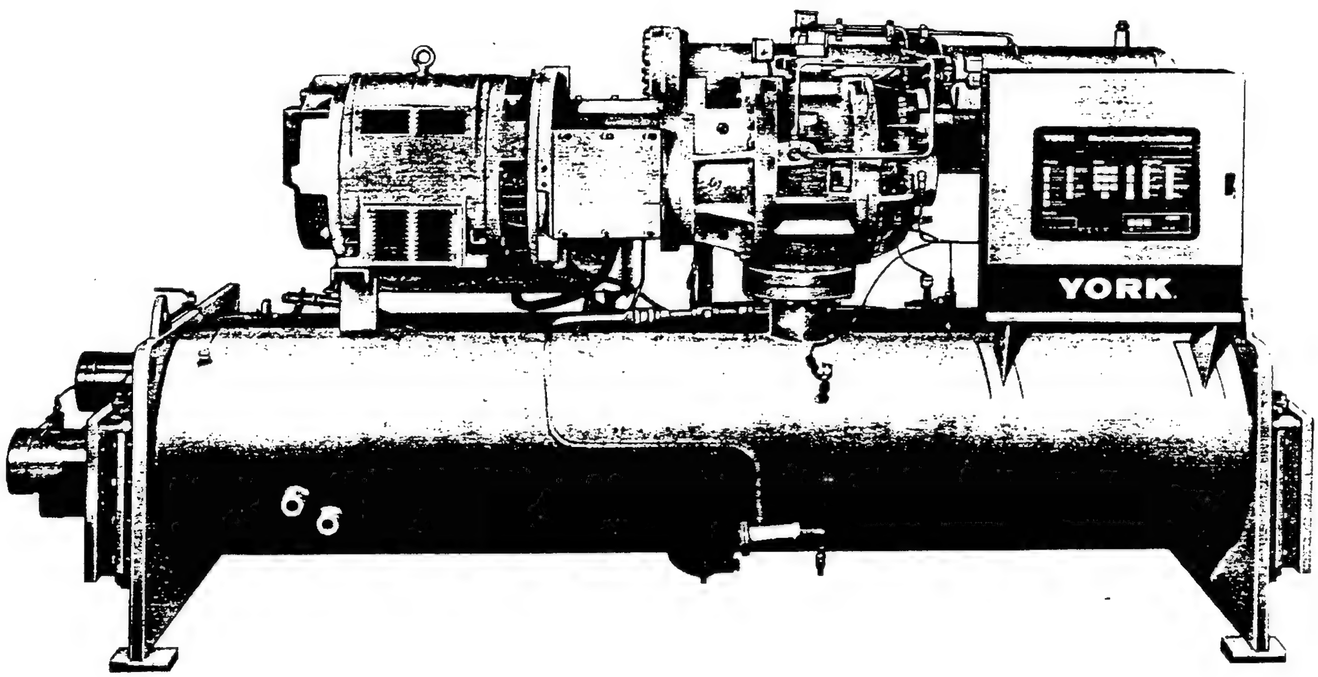
** UCARTHERM® is a registered trademark of Union Carbide Corporation, U.S.A.

FORM 160.47-EG1 (491)

YORK

CodePak™

Rotary Screw Liquid Chillers



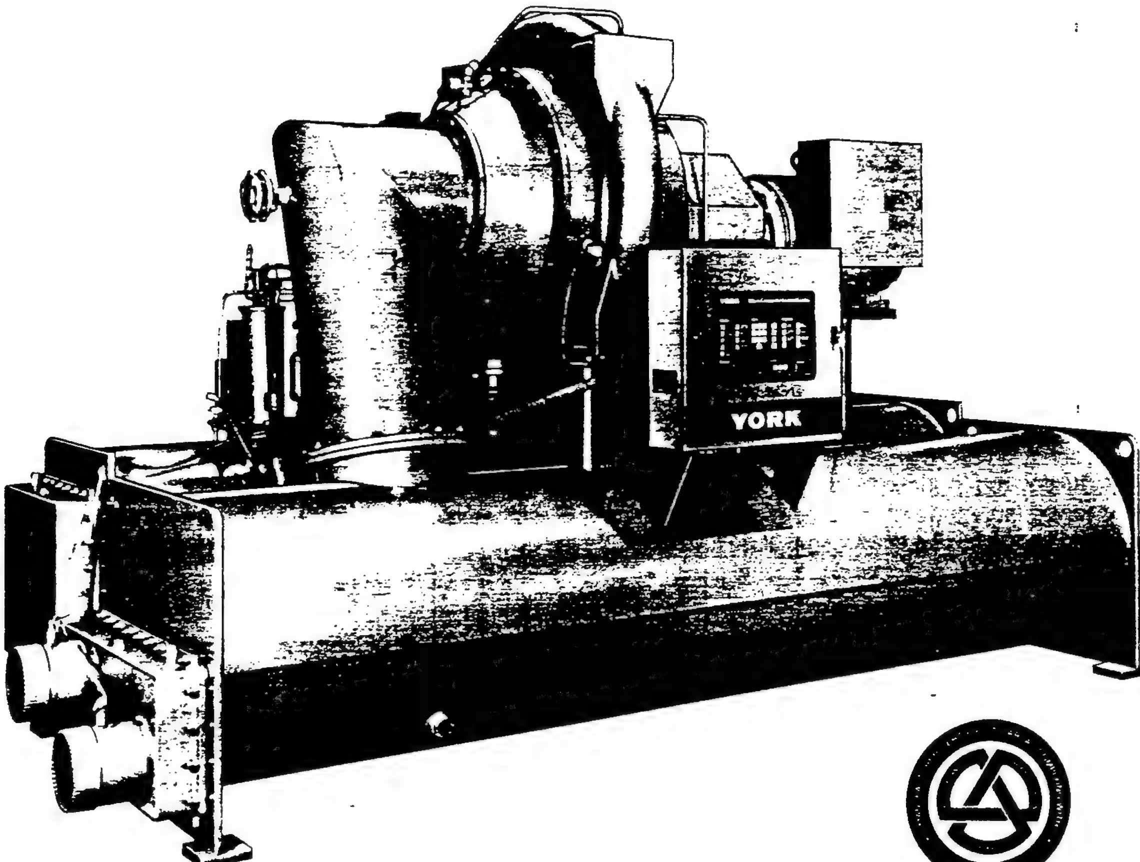
125 through 675 tons

FORM 160.46-EG1 (1191)

YORK

CodePak™

Centrifugal Liquid Chillers



Rated in Accordance with
ARI Standard 550-90

MODEL YT
150 THROUGH 1000 TONS

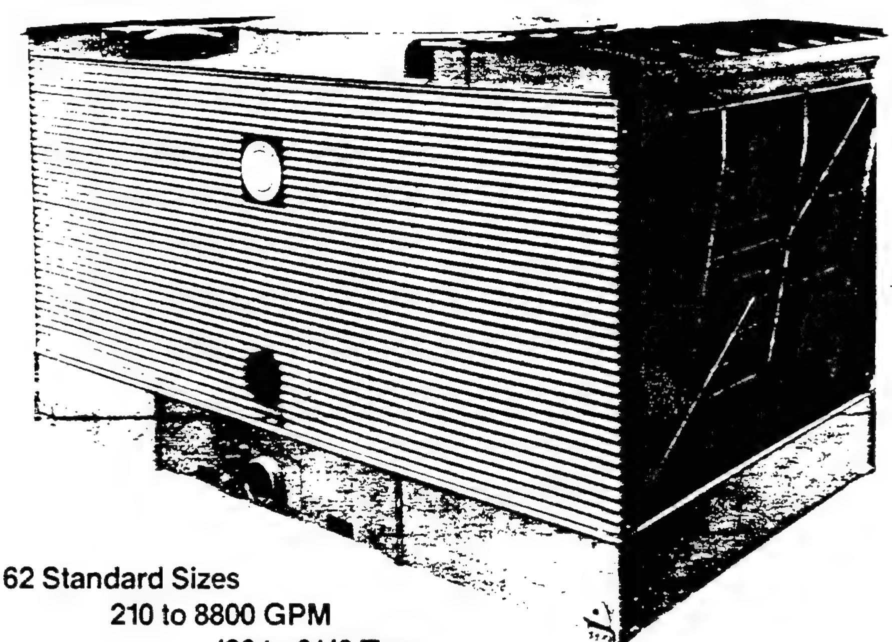
FULLY COMPATIBLE WITH R-11 AND R-123

B.A.C. Baltimore Aircoil

MORE SIZES
MORE FEATURES

Series 3000
INDUSTRIAL
COOLING TOWERS

CTI **Thermal Performance Certified by the Cooling Tower Institute**



62 Standard Sizes
210 to 8800 GPM
130 to 2110 Tons

Featuring:
- The New EASY CONNECT™ Piping Arrangement
- The BALANCE CLEAN™ Chamber
- Fiberglass-Reinforced Polyester casing and louvers

APPENDIX D

COOLING LOAD AND DEMAND PROFILE COMPUTER PRINTOUTS

ECO IH-1

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	2,200
2	67.8	64.4	0.0	0.0	0.0	2,200
3	67.0	63.5	0.0	0.0	0.0	2,200
4	66.4	62.7	0.0	0.0	0.0	2,200
5	66.3	62.7	0.0	0.0	0.0	2,200
6	66.6	63.7	0.0	0.0	0.0	2,200
7	67.6	64.5	0.0	0.0	0.0	2,200
8	69.3	65.1	0.0	0.0	0.0	2,200
9	71.8	66.0	65.3	65.3	81.7	2,200
10	74.6	67.6	109.2	109.2	101.0	2,200
11	77.8	69.8	241.8	241.8	167.7	2,200
12	80.9	71.9	384.5	384.5	255.8	2,200
13	83.2	73.5	353.7	353.7	240.6	2,200
14	84.7	74.4	435.0	435.0	296.8	2,200
15	85.3	74.6	542.1	542.1	380.6	2,200
16	84.7	74.5	682.4	630.0	456.8	2,148
17	83.4	73.5	806.8	630.0	453.0	1,971
18	81.3	71.5	768.0	630.0	445.6	1,833
19	78.8	70.1	652.3	630.0	440.5	1,811
20	76.3	70.0	591.1	591.1	406.5	1,811
21	74.2	69.5	546.4	546.4	367.8	1,811
22	72.3	68.7	422.4	422.4	272.9	1,811
23	70.8	67.1	246.2	246.2	164.9	1,811
24	69.7	65.8	170.5	170.5	125.9	1,811

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	119.5	485.0	454.0	2,175	125.9	211.4	192.1	2,200
2	66.0	63.9	103.2	130.3	133.7	2,200	102.7	102.7	94.1	2,200
3	64.6	62.4	79.4	79.4	83.5	2,200	79.5	79.5	83.5	2,200
4	63.7	61.3	65.3	65.3	77.2	2,200	65.3	65.3	77.2	2,200
5	63.0	60.8	69.4	69.4	78.2	2,200	69.4	69.4	78.2	2,200
6	62.8	61.2	153.4	153.4	111.8	2,200	153.5	153.5	111.8	2,200
7	63.4	61.7	195.5	195.5	131.0	2,200	195.5	195.5	131.0	2,200
8	65.1	62.3	185.3	185.3	127.3	2,200	185.6	185.6	127.4	2,200
9	67.6	63.3	220.8	220.8	145.4	2,200	220.8	220.8	145.4	2,200
10	70.7	65.2	286.9	286.9	182.3	2,200	286.9	286.9	182.4	2,200
11	74.0	67.5	432.3	432.3	276.7	2,200	432.3	432.3	276.7	2,200
12	77.1	69.8	557.6	557.6	377.9	2,200	557.6	557.6	377.9	2,200
13	79.6	71.6	535.2	535.2	365.3	2,200	535.2	535.2	365.3	2,200

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	534.2	368.0	2,200	534.2	534.2	368.0	2,200
15	81.8	72.8	561.4	561.4	390.8	2,200	561.4	561.4	390.8	2,200
16	81.6	73.1	609.6	609.6	433.3	2,200	609.6	609.6	433.3	2,200
17	81.0	72.7	678.8	630.0	450.0	2,151	678.8	630.0	450.0	2,151
18	80.0	71.6	665.1	630.0	445.9	2,116	665.1	630.0	445.9	2,116
19	78.7	71.3	542.0	542.0	369.9	2,116	542.0	542.0	369.9	2,116
20	77.1	72.0	496.4	496.4	335.9	2,116	496.4	496.4	335.9	2,116
21	75.3	71.8	448.1	448.1	299.1	2,116	448.1	448.1	299.1	2,116
22	73.3	71.0	338.5	338.5	224.9	2,116	338.5	338.5	224.9	2,116
23	71.3	68.9	227.4	227.4	158.6	2,116	227.4	227.4	158.6	2,116
24	69.4	66.8	158.1	158.1	121.6	2,116	158.1	158.1	121.6	2,116

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	125.9	211.4	192.1	2,200	125.9	211.4	192.1	2,200
2	66.0	63.9	102.7	102.7	94.1	2,200	102.7	102.7	94.1	2,200
3	64.6	62.4	79.5	79.5	83.5	2,200	79.5	79.5	83.5	2,200
4	63.7	61.3	65.3	65.3	77.2	2,200	65.3	65.3	77.2	2,200
5	63.0	60.8	69.4	69.4	78.2	2,200	69.4	69.4	78.2	2,200
6	62.8	61.2	153.5	153.5	111.8	2,200	153.5	153.5	111.8	2,200
7	63.4	61.7	195.5	195.5	131.0	2,200	195.5	195.5	131.0	2,200
8	65.1	62.3	185.6	185.6	127.4	2,200	185.6	185.6	127.4	2,200
9	67.6	63.3	220.8	220.8	145.4	2,200	220.8	220.8	145.4	2,200
10	70.7	65.2	286.9	286.9	182.4	2,200	286.9	286.9	182.4	2,200
11	74.0	67.5	432.3	432.3	276.7	2,200	432.3	432.3	276.7	2,200
12	77.1	69.8	557.6	557.6	377.9	2,200	557.6	557.6	377.9	2,200
13	79.6	71.6	535.2	535.2	365.3	2,200	535.2	535.2	365.3	2,200
14	81.3	72.7	534.2	534.2	368.0	2,200	534.2	534.2	368.0	2,200
15	81.8	72.8	561.4	561.4	390.8	2,200	561.4	561.4	390.8	2,200
16	81.6	73.1	609.6	609.6	433.3	2,200	609.6	609.6	433.3	2,200
17	81.0	72.7	678.8	630.0	450.0	2,151	678.8	630.0	450.0	2,151
18	80.0	71.6	665.1	630.0	445.9	2,116	665.1	630.0	445.9	2,116
19	78.7	71.3	542.0	542.0	369.9	2,116	542.0	542.0	369.9	2,116
20	77.1	72.0	496.4	496.4	335.9	2,116	496.4	496.4	335.9	2,116
21	75.3	71.8	448.1	448.1	299.1	2,116	448.1	448.1	299.1	2,116
22	73.3	71.0	338.5	338.5	224.9	2,116	338.5	338.5	224.9	2,116
23	71.3	68.9	227.4	227.4	158.6	2,116	227.4	227.4	158.6	2,116
24	69.4	66.8	158.1	158.1	121.6	2,116	158.1	158.1	121.6	2,116

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

July

Hour	Design ODDB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	258.3	343.8	313.0	2,200
2	72.3	67.9	206.7	206.7	146.4	2,200
3	71.4	67.2	185.6	185.6	135.0	2,200
4	70.7	67.0	180.9	180.9	132.5	2,200
5	70.5	66.9	252.9	252.9	168.0	2,200
6	71.0	67.4	326.9	326.9	209.4	2,200
7	72.1	68.4	380.7	380.7	244.4	2,200
8	74.1	69.3	401.4	401.4	260.1	2,200
9	77.0	70.1	420.6	420.6	275.2	2,200
10	80.4	71.4	494.4	494.4	332.6	2,200
11	84.2	73.3	672.3	630.0	452.3	2,158
12	87.8	75.5	775.6	630.0	460.7	2,012
13	90.5	76.5	733.0	630.0	464.6	1,909
14	92.3	76.8	763.3	630.0	465.8	1,776
15	93.0	77.0	805.4	630.0	466.6	1,600
16	92.3	76.7	891.8	630.0	465.4	1,339
17	90.8	75.3	889.6	630.0	459.9	1,079
18	88.3	74.2	860.2	630.0	455.7	849
19	85.4	72.9	714.1	630.0	450.8	765
20	82.4	73.4	680.5	630.0	452.6	714
21	80.0	73.0	641.2	630.0	451.1	703
22	77.7	72.3	559.5	559.5	387.6	703
23	75.9	70.6	426.3	426.3	280.4	703
24	74.6	69.4	280.2	280.2	187.6	703

Hour	Typical ODDB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	259.7	485.0	476.6	928	265.3	485.0	476.6	1,782
2	71.9	68.8	219.9	485.0	467.7	1,192	214.6	485.0	467.7	2,051
3	69.9	67.0	167.1	485.0	460.5	1,509	167.3	318.4	283.8	2,200
4	68.3	65.9	152.3	485.0	456.3	1,841	152.7	152.7	117.9	2,200
5	67.4	65.2	203.0	485.0	453.6	2,121	203.1	203.1	140.2	2,200
6	67.0	64.9	256.9	337.4	295.6	2,200	256.9	256.9	166.1	2,200
7	67.5	65.3	274.1	274.1	175.8	2,200	274.2	274.2	175.9	2,200
8	68.8	65.6	262.6	262.6	170.5	2,200	262.6	262.6	170.5	2,200
9	70.9	65.7	248.7	248.7	163.5	2,200	248.7	248.7	163.5	2,200
10	73.6	66.5	305.3	305.3	195.2	2,200	305.3	305.3	195.2	2,200
11	76.7	67.9	454.0	454.0	293.0	2,200	454.0	454.0	293.0	2,200
12	79.9	69.9	581.5	581.5	398.0	2,200	581.5	581.5	398.0	2,200
13	83.0	71.3	563.2	563.2	387.4	2,200	563.2	563.2	387.4	2,200

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	597.7	420.7	2,200	597.7	597.7	420.7	2,200
15	87.8	73.9	654.3	630.0	454.5	2,176	654.3	630.0	454.5	2,176
16	89.1	75.3	737.3	630.0	459.9	2,068	737.3	630.0	459.9	2,068
17	89.5	75.5	810.6	630.0	460.7	1,888	810.6	630.0	460.7	1,888
18	89.2	76.2	803.8	630.0	463.4	1,714	803.8	630.0	463.4	1,714
19	88.3	76.7	700.3	630.0	465.4	1,644	700.3	630.0	465.4	1,644
20	86.7	78.6	684.0	630.0	472.9	1,590	684.0	630.0	472.9	1,590
21	84.7	78.8	656.5	630.0	473.7	1,563	656.5	630.0	473.7	1,563
22	82.3	78.0	549.7	549.7	398.5	1,563	549.7	549.7	398.5	1,563
23	79.6	75.4	419.7	419.7	289.3	1,563	419.7	419.7	289.3	1,563
24	76.9	73.0	325.9	325.9	222.1	1,563	325.9	325.9	222.1	1,563

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	265.3	485.0	476.6	1,782	265.3	485.0	476.6	1,782
2	71.9	68.8	214.6	485.0	467.7	2,051	214.6	485.0	467.7	2,051
3	69.9	67.0	167.3	318.4	283.8	2,200	167.3	318.4	283.8	2,200
4	68.3	65.9	152.7	152.7	117.9	2,200	152.7	152.7	117.9	2,200
5	67.4	65.2	203.1	203.1	140.2	2,200	203.1	203.1	140.2	2,200
6	67.0	64.9	256.9	256.9	166.1	2,200	256.9	256.9	166.1	2,200
7	67.5	65.3	274.2	274.2	175.9	2,200	274.2	274.2	175.9	2,200
8	68.8	65.6	262.6	262.6	170.5	2,200	262.6	262.6	170.5	2,200
9	70.9	65.7	248.7	248.7	163.5	2,200	248.7	248.7	163.5	2,200
10	73.6	66.5	305.3	305.3	195.2	2,200	305.3	305.3	195.2	2,200
11	76.7	67.9	454.0	454.0	293.0	2,200	454.0	454.0	293.0	2,200
12	79.9	69.9	581.5	581.5	398.0	2,200	581.5	581.5	398.0	2,200
13	83.0	71.3	563.2	563.2	387.4	2,200	563.2	563.2	387.4	2,200
14	85.7	72.5	597.7	597.7	420.7	2,200	597.7	597.7	420.7	2,200
15	87.8	73.9	654.3	630.0	454.5	2,176	654.3	630.0	454.5	2,176
16	89.1	75.3	737.3	630.0	459.9	2,068	737.3	630.0	459.9	2,068
17	89.5	75.5	810.6	630.0	460.7	1,888	810.6	630.0	460.7	1,888
18	89.2	76.2	803.8	630.0	463.4	1,714	803.8	630.0	463.4	1,714
19	88.3	76.7	700.3	630.0	465.4	1,644	700.3	630.0	465.4	1,644
20	86.7	78.6	684.0	630.0	472.9	1,590	684.0	630.0	472.9	1,590
21	84.7	78.8	656.5	630.0	473.7	1,563	656.5	630.0	473.7	1,563
22	82.3	78.0	549.7	549.7	398.5	1,563	549.7	549.7	398.5	1,563
23	79.6	75.4	419.7	419.7	289.3	1,563	419.7	419.7	289.3	1,563
24	76.9	73.0	325.9	325.9	222.1	1,563	325.9	325.9	222.1	1,563

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

	Design		Design			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.5	64.5	164.0	485.0	451.0	1,883
2	69.5	63.5	133.5	452.1	409.4	2,200
3	68.7	63.0	120.1	120.1	100.2	2,200
4	68.1	62.4	107.0	107.0	94.1	2,200
5	67.9	62.6	162.3	162.3	117.6	2,200
6	68.3	63.2	240.7	240.7	154.8	2,200
7	69.3	64.1	261.5	261.5	166.9	2,200
8	71.1	64.9	292.4	292.4	184.6	2,200
9	73.7	66.1	328.4	328.4	207.2	2,200
10	76.8	67.2	406.9	406.9	258.8	2,200
11	80.2	68.9	583.6	583.6	396.4	2,200
12	83.4	70.6	695.3	630.0	442.3	2,135
13	85.8	71.5	664.3	630.0	445.6	2,100
14	87.5	72.5	698.6	630.0	449.3	2,032
15	88.1	72.7	727.3	630.0	450.0	1,934
16	87.5	71.7	794.2	630.0	446.3	1,770
17	86.0	70.6	806.4	630.0	442.3	1,594
18	83.8	69.7	758.7	630.0	439.1	1,465
19	81.2	68.5	598.2	598.2	407.5	1,465
20	78.6	68.7	545.2	545.2	364.4	1,465
21	76.4	68.8	454.4	454.4	295.6	1,465
22	74.3	67.6	321.1	321.1	206.5	1,465
23	72.7	66.4	220.8	220.8	150.8	1,465
24	71.5	65.3	194.9	194.9	136.4	1,465

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	145.1	485.0	454.0	1,804	150.5	200.7	184.2	2,200
2	68.2	63.5	116.3	485.0	447.3	2,171	115.6	115.6	98.9	2,200
3	66.6	62.2	88.4	119.1	124.0	2,200	88.6	88.6	86.7	2,200
4	65.4	61.1	72.4	72.4	79.6	2,200	72.3	72.3	79.6	2,200
5	64.6	60.7	101.2	101.2	89.9	2,200	101.5	101.5	90.1	2,200
6	64.4	60.7	175.6	175.6	120.6	2,200	175.5	175.5	120.6	2,200
7	64.9	61.2	173.0	173.0	120.2	2,200	173.0	173.0	120.2	2,200
8	66.3	61.6	179.8	179.8	123.8	2,200	180.0	180.0	123.9	2,200
9	68.5	62.5	178.1	178.1	124.4	2,200	178.0	178.0	124.4	2,200
10	71.4	63.6	250.5	250.5	160.4	2,200	250.6	250.6	160.5	2,200
11	74.5	65.1	396.0	396.0	246.7	2,200	396.0	396.0	246.7	2,200
12	77.6	66.8	504.8	504.8	327.3	2,200	504.8	504.8	327.3	2,200
13	80.5	68.2	495.1	495.1	323.9	2,200	495.1	495.1	323.9	2,200

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	525.9	352.0	2,200	525.9	525.9	352.0	2,200
15	84.2	70.7	562.3	562.3	384.6	2,200	562.3	562.3	384.6	2,200
16	84.6	70.5	612.6	612.6	426.7	2,200	612.6	612.6	426.7	2,200
17	84.4	70.4	668.2	630.0	441.6	2,162	668.2	630.0	441.6	2,162
18	83.6	70.7	640.3	630.0	442.7	2,152	640.3	630.0	442.7	2,152
19	82.4	70.7	496.1	496.1	331.8	2,152	496.1	496.1	331.8	2,152
20	80.8	71.9	476.3	476.3	320.2	2,152	476.3	476.3	320.2	2,152
21	78.9	72.4	433.7	433.7	290.3	2,152	433.7	433.7	290.3	2,152
22	76.8	71.1	330.5	330.5	220.3	2,152	330.5	330.5	220.3	2,152
23	74.5	69.3	243.3	243.3	167.5	2,152	243.3	243.3	167.5	2,152
24	72.2	67.2	198.3	198.3	141.1	2,152	198.3	198.3	141.1	2,152

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	150.5	200.7	184.2	2,200	150.5	200.7	184.2	2,200
2	68.2	63.5	115.6	115.6	98.9	2,200	115.6	115.6	98.9	2,200
3	66.6	62.2	88.6	88.6	86.7	2,200	88.6	88.6	86.7	2,200
4	65.4	61.1	72.3	72.3	79.6	2,200	72.3	72.3	79.6	2,200
5	64.6	60.7	101.5	101.5	90.1	2,200	101.5	101.5	90.1	2,200
6	64.4	60.7	175.5	175.5	120.6	2,200	175.5	175.5	120.6	2,200
7	64.9	61.2	173.0	173.0	120.2	2,200	173.0	173.0	120.2	2,200
8	66.3	61.6	180.0	180.0	123.9	2,200	180.0	180.0	123.9	2,200
9	68.5	62.5	178.0	178.0	124.4	2,200	178.0	178.0	124.4	2,200
10	71.4	63.6	250.6	250.6	160.5	2,200	250.6	250.6	160.5	2,200
11	74.5	65.1	396.0	396.0	246.7	2,200	396.0	396.0	246.7	2,200
12	77.6	66.8	504.8	504.8	327.3	2,200	504.8	504.8	327.3	2,200
13	80.5	68.2	495.1	495.1	323.9	2,200	495.1	495.1	323.9	2,200
14	82.7	69.7	525.9	525.9	352.0	2,200	525.9	525.9	352.0	2,200
15	84.2	70.7	562.3	562.3	384.6	2,200	562.3	562.3	384.6	2,200
16	84.6	70.5	612.6	612.6	426.7	2,200	612.6	612.6	426.7	2,200
17	84.4	70.4	668.2	630.0	441.6	2,162	668.2	630.0	441.6	2,162
18	83.6	70.7	640.3	630.0	442.7	2,152	640.3	630.0	442.7	2,152
19	82.4	70.7	496.1	496.1	331.8	2,152	496.1	496.1	331.8	2,152
20	80.8	71.9	476.3	476.3	320.2	2,152	476.3	476.3	320.2	2,152
21	78.9	72.4	433.7	433.7	290.3	2,152	433.7	433.7	290.3	2,152
22	76.8	71.1	330.5	330.5	220.3	2,152	330.5	330.5	220.3	2,152
23	74.5	69.3	243.3	243.3	167.5	2,152	243.3	243.3	167.5	2,152
24	72.2	67.2	198.3	198.3	141.1	2,152	198.3	198.3	141.1	2,152

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

September

	Design		---- Design ----			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	64.3	60.7	76.6	126.8	126.4	2,200
2	63.3	59.8	60.2	60.2	71.7	2,200
3	62.4	59.2	48.1	48.1	57.2	2,200
4	61.8	58.5	35.4	35.4	42.0	2,200
5	61.6	58.3	42.2	42.2	50.2	2,200
6	62.0	58.7	54.3	54.3	64.5	2,200
7	63.1	59.8	142.1	142.1	105.5	2,200
8	64.9	61.3	146.5	146.5	109.0	2,200
9	67.5	62.3	207.6	207.6	137.5	2,200
10	70.6	63.4	305.6	305.6	188.9	2,200
11	74.0	65.1	491.7	491.7	312.9	2,200
12	77.3	66.6	611.3	611.3	412.3	2,200
13	79.7	68.1	579.7	579.7	390.6	2,200
14	81.3	68.9	596.3	596.3	407.2	2,200
15	81.9	69.3	623.8	623.8	432.2	2,200
16	81.3	68.8	684.1	630.0	435.9	2,146
17	79.9	68.2	694.6	630.0	433.8	2,081
18	77.7	67.0	653.5	630.0	429.7	2,058
19	75.0	66.9	506.2	506.2	328.6	2,058
20	72.4	66.6	369.5	369.5	233.2	2,058
21	70.2	65.3	283.2	283.2	180.6	2,058
22	68.1	63.7	169.8	169.8	122.4	2,058
23	66.5	62.5	112.6	112.6	96.5	2,058
24	65.3	61.6	96.5	96.5	89.1	2,058

	Typical		---- Weekday ----				---- Saturday ----			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	68.5	212.3	184.2	2,200	74.8	74.8	80.9	2,200
2	62.0	59.7	47.6	47.6	56.8	2,200	48.1	48.1	57.3	2,200
3	60.4	58.4	26.6	26.6	31.6	2,200	26.6	26.6	31.6	2,200
4	59.2	57.1	15.4	15.4	18.3	2,200	15.4	15.4	18.3	2,200
5	58.4	56.3	19.2	19.2	22.8	2,200	19.2	19.2	22.8	2,200
6	58.2	56.1	24.3	24.3	28.9	2,200	24.3	24.3	28.9	2,200
7	58.7	56.7	8.4	0.0	0.0	2,200	8.4	0.0	0.0	2,200
8	60.1	57.9	87.6	87.6	83.9	2,200	87.6	87.6	83.9	2,200
9	62.4	58.6	79.2	79.2	80.8	2,200	79.2	79.2	80.8	2,200
10	65.2	59.6	142.2	142.2	105.5	2,200	142.9	142.9	105.8	2,200
11	68.3	61.1	275.3	275.3	168.4	2,200	275.3	275.3	168.4	2,200
12	71.5	62.7	415.0	415.0	253.6	2,200	415.0	415.0	253.6	2,200
13	74.3	64.6	413.9	413.9	257.3	2,200	414.3	414.3	257.5	2,200

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	456.6	289.9	2,200	456.6	456.6	289.9	2,200
15	78.0	67.1	465.5	465.5	299.1	2,200	465.5	465.5	299.1	2,200
16	78.5	67.5	514.5	514.5	336.7	2,200	514.5	514.5	336.7	2,200
17	78.2	67.9	550.9	550.9	366.5	2,200	550.9	550.9	366.5	2,200
18	77.5	68.0	499.0	499.0	326.3	2,200	499.0	499.0	326.3	2,200
19	76.3	69.3	379.7	379.7	245.9	2,200	379.7	379.7	245.9	2,200
20	74.7	70.0	348.0	348.0	228.1	2,200	348.0	348.0	228.1	2,200
21	72.7	69.0	290.0	290.0	192.2	2,200	290.0	290.0	192.2	2,200
22	70.6	67.3	190.0	190.0	137.3	2,200	190.0	190.0	137.3	2,200
23	68.3	65.4	121.4	121.4	103.6	2,200	121.4	121.4	103.6	2,200
24	66.1	63.6	104.2	104.2	94.3	2,200	104.2	104.2	94.3	2,200

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	63.9	61.5	74.8	74.8	80.9	2,200	74.8	74.8	80.9	2,200
2	62.0	59.7	48.1	48.1	57.3	2,200	48.1	48.1	57.3	2,200
3	60.4	58.4	26.6	26.6	31.6	2,200	26.6	26.6	31.6	2,200
4	59.2	57.1	15.4	15.4	18.3	2,200	15.4	15.4	18.3	2,200
5	58.4	56.3	19.2	19.2	22.8	2,200	19.2	19.2	22.8	2,200
6	58.2	56.1	24.3	24.3	28.9	2,200	24.3	24.3	28.9	2,200
7	58.7	56.7	8.4	0.0	0.0	2,200	8.4	0.0	0.0	2,200
8	60.1	57.9	87.6	87.6	83.9	2,200	87.6	87.6	83.9	2,200
9	62.4	58.6	79.2	79.2	80.8	2,200	79.2	79.2	80.8	2,200
10	65.2	59.6	142.9	142.9	105.8	2,200	142.9	142.9	105.8	2,200
11	68.3	61.1	275.3	275.3	168.4	2,200	275.3	275.3	168.4	2,200
12	71.5	62.7	415.0	415.0	253.6	2,200	415.0	415.0	253.6	2,200
13	74.3	64.6	414.3	414.3	257.5	2,200	414.3	414.3	257.5	2,200
14	76.6	66.0	456.6	456.6	289.9	2,200	456.6	456.6	289.9	2,200
15	78.0	67.1	465.5	465.5	299.1	2,200	465.5	465.5	299.1	2,200
16	78.5	67.5	514.5	514.5	336.7	2,200	514.5	514.5	336.7	2,200
17	78.2	67.9	550.9	550.9	366.5	2,200	550.9	550.9	366.5	2,200
18	77.5	68.0	499.0	499.0	326.3	2,200	499.0	499.0	326.3	2,200
19	76.3	69.3	379.7	379.7	245.9	2,200	379.7	379.7	245.9	2,200
20	74.7	70.0	348.0	348.0	228.1	2,200	348.0	348.0	228.1	2,200
21	72.7	69.0	290.0	290.0	192.2	2,200	290.0	290.0	192.2	2,200
22	70.6	67.3	190.0	190.0	137.3	2,200	190.0	190.0	137.3	2,200
23	68.3	65.4	121.4	121.4	103.6	2,200	121.4	121.4	103.6	2,200
24	66.1	63.6	104.2	104.2	94.3	2,200	104.2	104.2	94.3	2,200

ECO IH-2

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

June

Hour	Design DADB (F)	Design DAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	5,000
2	67.8	64.4	0.0	0.0	0.0	5,000
3	67.0	63.5	0.0	0.0	0.0	5,000
4	66.4	62.7	0.0	0.0	0.0	5,000
5	66.3	62.7	0.0	0.0	0.0	5,000
6	66.6	63.7	0.0	0.0	0.0	5,000
7	67.6	64.5	0.0	0.0	0.0	5,000
8	69.3	65.1	0.0	0.0	0.0	5,000
9	71.8	66.0	65.3	65.3	84.5	5,000
10	74.6	67.6	109.2	109.2	142.9	5,000
11	77.8	69.8	241.8	241.8	208.0	5,000
12	80.9	71.9	384.5	0.0	0.0	4,611
13	83.2	73.5	353.7	0.0	0.0	4,254
14	84.7	74.4	435.0	0.0	0.0	3,816
15	85.3	74.6	542.1	0.0	0.0	3,271
16	84.7	74.5	682.4	0.0	0.0	2,586
17	83.4	73.5	806.8	0.0	0.0	1,777
18	81.3	71.5	768.0	768.0	508.9	1,777
19	78.8	70.1	652.3	652.3	427.2	1,777
20	76.3	70.0	591.1	591.1	390.2	1,777
21	74.2	69.5	546.4	546.4	362.4	1,777
22	72.3	68.7	422.4	422.4	292.5	1,777
23	70.8	67.1	246.2	246.2	203.7	1,777
24	69.7	65.8	170.5	170.5	168.7	1,777

Hour	Typical DADB (F)	Typical DAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	119.5	885.0	828.4	2,541	125.9	885.0	828.4	2,264
2	66.0	63.9	103.2	885.0	818.9	3,321	102.7	885.0	818.9	3,044
3	64.6	62.4	79.4	885.0	808.9	4,123	79.5	885.0	808.9	3,847
4	63.7	61.3	65.3	885.0	801.9	4,940	65.3	885.0	801.9	4,664
5	63.0	60.8	69.4	133.4	174.9	5,000	69.4	409.1	348.9	5,000
6	62.8	61.2	153.4	153.4	153.3	5,000	153.5	153.5	153.4	5,000
7	63.4	61.7	195.5	195.5	170.4	5,000	195.5	195.5	170.4	5,000
8	65.1	62.3	185.3	185.3	167.6	5,000	185.6	185.6	167.7	5,000
9	67.6	63.3	220.8	220.8	184.2	5,000	220.8	220.8	184.2	5,000
10	70.7	65.2	286.9	286.9	217.1	5,000	286.9	286.9	217.2	5,000
11	74.0	67.5	432.3	432.3	293.6	5,000	432.3	432.3	293.6	5,000
12	77.1	69.8	557.6	0.0	0.0	4,438	557.6	0.0	0.0	4,438
13	79.6	71.6	535.2	0.0	0.0	3,900	535.2	0.0	0.0	3,900

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

			Weekday				Saturday			
Hour	Typical ODDB (F)	Typical OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	0.0	0.0	3,362	534.2	0.0	0.0	3,362
15	81.8	72.8	561.4	0.0	0.0	2,798	561.4	0.0	0.0	2,798
16	81.6	73.1	609.6	0.0	0.0	2,186	609.6	0.0	0.0	2,186
17	81.0	72.7	678.8	0.0	0.0	1,506	678.8	0.0	0.0	1,506
18	80.0	71.6	665.1	665.1	442.2	1,506	665.1	665.1	442.2	1,506
19	78.7	71.3	542.0	542.0	367.2	1,506	542.0	542.0	367.2	1,506
20	77.1	72.0	496.4	496.4	344.0	1,506	496.4	496.4	344.0	1,506
21	75.3	71.8	448.1	448.1	316.5	1,506	448.1	448.1	316.5	1,506
22	73.3	71.0	338.5	338.5	257.1	1,506	338.5	338.5	257.1	1,506
23	71.3	68.9	227.4	227.4	199.5	1,506	227.4	227.4	199.5	1,506
24	69.4	66.8	158.1	158.1	165.7	1,506	158.1	158.1	165.7	1,506

			Sunday				Monday			
Hour	Typical OADB (F)	Typical OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	125.9	885.0	828.4	2,264	125.9	885.0	828.4	2,264
2	66.0	63.9	102.7	885.0	818.9	3,044	102.7	885.0	818.9	3,044
3	64.6	62.4	79.5	885.0	808.9	3,847	79.5	885.0	808.9	3,847
4	63.7	61.3	65.3	885.0	801.9	4,664	65.3	885.0	801.9	4,664
5	63.0	60.8	69.4	409.1	348.9	5,000	69.4	409.1	348.9	5,000
6	62.8	61.2	153.5	153.5	153.4	5,000	153.5	153.5	153.4	5,000
7	63.4	61.7	195.5	195.5	170.4	5,000	195.5	195.5	170.4	5,000
8	65.1	62.3	185.6	185.6	167.7	5,000	185.6	185.6	167.7	5,000
9	67.6	63.3	220.8	220.8	184.2	5,000	220.8	220.8	184.2	5,000
10	70.7	65.2	286.9	286.9	217.2	5,000	286.9	286.9	217.2	5,000
11	74.0	67.5	432.3	432.3	293.6	5,000	432.3	432.3	293.6	5,000
12	77.1	69.8	557.6	0.0	0.0	4,438	557.6	0.0	0.0	4,438
13	79.6	71.6	535.2	0.0	0.0	3,900	535.2	0.0	0.0	3,900
14	81.3	72.7	534.2	0.0	0.0	3,362	534.2	0.0	0.0	3,362
15	81.8	72.8	561.4	0.0	0.0	2,798	561.4	0.0	0.0	2,798
16	81.6	73.1	609.6	0.0	0.0	2,186	609.6	0.0	0.0	2,186
17	81.0	72.7	678.8	0.0	0.0	1,506	678.8	0.0	0.0	1,506
18	80.0	71.6	665.1	665.1	442.2	1,506	665.1	665.1	442.2	1,506
19	78.7	71.3	542.0	542.0	367.2	1,506	542.0	542.0	367.2	1,506
20	77.1	72.0	496.4	496.4	344.0	1,506	496.4	496.4	344.0	1,506
21	75.3	71.8	448.1	448.1	316.5	1,506	448.1	448.1	316.5	1,506
22	73.3	71.0	338.5	338.5	257.1	1,506	338.5	338.5	257.1	1,506
23	71.3	68.9	227.4	227.4	199.5	1,506	227.4	227.4	199.5	1,506
24	69.4	66.8	158.1	158.1	165.7	1,506	158.1	158.1	165.7	1,506

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

	Design		Design			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	73.4	68.8	258.3	885.0	853.3	2,131
2	72.3	67.9	206.7	885.0	846.8	2,808
3	71.4	67.2	185.6	885.0	841.8	3,505
4	70.7	67.0	180.9	885.0	840.3	4,206
5	70.5	66.9	252.9	885.0	839.6	4,835
6	71.0	67.4	326.9	495.6	446.6	5,000
7	72.1	68.4	380.7	380.7	270.4	5,000
8	74.1	69.3	401.4	401.4	283.7	5,000
9	77.0	70.1	420.6	420.6	296.2	5,000
10	80.4	71.4	494.4	494.4	340.6	5,000
11	84.2	73.3	672.3	672.3	455.0	5,000
12	87.8	75.5	775.6	0.0	0.0	4,220
13	90.5	76.5	733.0	0.0	0.0	3,484
14	92.3	76.8	763.3	0.0	0.0	2,718
15	93.0	77.0	805.4	0.0	0.0	1,910
16	92.3	76.7	891.8	0.0	0.0	1,017
17	90.8	75.3	889.6	0.0	0.0	127
18	88.3	74.2	860.2	860.2	589.6	127
19	85.4	72.9	714.1	714.1	479.9	127
20	82.4	73.4	680.5	680.5	460.7	127
21	80.0	73.0	641.2	641.2	434.0	127
22	77.7	72.3	559.5	559.5	381.4	127
23	75.9	70.6	426.3	426.3	300.8	127
24	74.6	69.4	280.2	280.2	224.7	127

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	259.7	885.0	869.7	752	265.3	885.0	869.7	1,657
2	71.9	68.8	219.9	885.0	853.3	1,416	214.6	885.0	853.3	2,326
3	69.9	67.0	167.1	885.0	840.3	2,133	167.3	885.0	840.3	3,042
4	68.3	65.9	152.3	885.0	832.6	2,864	152.7	885.0	832.6	3,772
5	67.4	65.2	203.0	885.0	827.7	3,544	203.1	885.0	827.7	4,451
6	67.0	64.9	256.9	885.0	825.6	4,169	256.9	809.4	738.5	5,000
7	67.5	65.3	274.1	885.0	828.4	4,777	274.2	274.2	211.7	5,000
8	68.8	65.6	262.6	489.7	432.6	5,000	262.6	262.6	207.3	5,000
9	70.9	65.7	248.7	248.7	201.5	5,000	248.7	248.7	201.5	5,000
10	73.6	66.5	305.3	305.3	228.9	5,000	305.3	305.3	228.9	5,000
11	76.7	67.9	454.0	454.0	306.2	5,000	454.0	454.0	306.2	5,000
12	79.9	69.9	581.5	0.0	0.0	4,414	581.5	0.0	0.0	4,414
13	83.0	71.3	563.2	0.0	0.0	3,848	563.2	0.0	0.0	3,848

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	0.0	0.0	3,247	597.7	0.0	0.0	3,247
15	87.8	73.9	654.3	0.0	0.0	2,590	654.3	0.0	0.0	2,590
16	89.1	75.3	737.3	0.0	0.0	1,851	737.3	0.0	0.0	1,851
17	89.5	75.5	810.6	0.0	0.0	1,039	810.6	0.0	0.0	1,039
18	89.2	76.2	803.8	803.8	559.0	1,039	803.8	803.8	559.0	1,039
19	88.3	76.7	700.3	700.3	490.3	1,039	700.3	700.3	490.3	1,039
20	86.7	78.6	684.0	684.0	488.8	1,039	684.0	684.0	488.8	1,039
21	84.7	78.8	656.5	656.5	471.2	1,039	656.5	656.5	471.2	1,039
22	82.3	78.0	549.7	549.7	398.9	1,039	549.7	549.7	398.9	1,039
23	79.6	75.4	419.7	419.7	313.1	1,039	419.7	419.7	313.1	1,039
24	76.9	73.0	325.9	325.9	256.3	1,039	325.9	325.9	256.3	1,039

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	265.3	885.0	869.7	1,657	265.3	885.0	869.7	1,657
2	71.9	68.8	214.6	885.0	853.3	2,326	214.6	885.0	853.3	2,326
3	69.9	67.0	167.3	885.0	840.3	3,042	167.3	885.0	840.3	3,042
4	68.3	65.9	152.7	885.0	832.6	3,772	152.7	885.0	832.6	3,772
5	67.4	65.2	203.1	885.0	827.7	4,451	203.1	885.0	827.7	4,451
6	67.0	64.9	256.9	809.4	738.5	5,000	256.9	809.4	738.5	5,000
7	67.5	65.3	274.2	274.2	211.7	5,000	274.2	274.2	211.7	5,000
8	68.8	65.6	262.6	262.6	207.3	5,000	262.6	262.6	207.3	5,000
9	70.9	65.7	248.7	248.7	201.5	5,000	248.7	248.7	201.5	5,000
10	73.6	66.5	305.3	305.3	228.9	5,000	305.3	305.3	228.9	5,000
11	76.7	67.9	454.0	454.0	306.2	5,000	454.0	454.0	306.2	5,000
12	79.9	69.9	581.5	0.0	0.0	4,414	581.5	0.0	0.0	4,414
13	83.0	71.3	563.2	0.0	0.0	3,848	563.2	0.0	0.0	3,848
14	85.7	72.5	597.7	0.0	0.0	3,247	597.7	0.0	0.0	3,247
15	87.8	73.9	654.3	0.0	0.0	2,590	654.3	0.0	0.0	2,590
16	89.1	75.3	737.3	0.0	0.0	1,851	737.3	0.0	0.0	1,851
17	89.5	75.5	810.6	0.0	0.0	1,039	810.6	0.0	0.0	1,039
18	89.2	76.2	803.8	803.8	559.0	1,039	803.8	803.8	559.0	1,039
19	88.3	76.7	700.3	700.3	490.3	1,039	700.3	700.3	490.3	1,039
20	86.7	78.6	684.0	684.0	488.8	1,039	684.0	684.0	488.8	1,039
21	84.7	78.8	656.5	656.5	471.2	1,039	656.5	656.5	471.2	1,039
22	82.3	78.0	549.7	549.7	398.9	1,039	549.7	549.7	398.9	1,039
23	79.6	75.4	419.7	419.7	313.1	1,039	419.7	419.7	313.1	1,039
24	76.9	73.0	325.9	325.9	256.3	1,039	325.9	325.9	256.3	1,039

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	164.0	885.0	822.9	1,759
2	69.5	63.5	133.5	885.0	816.2	2,509
3	68.7	63.0	120.1	885.0	812.9	3,272
4	68.1	62.4	107.0	885.0	808.9	4,047
5	67.9	62.6	162.3	885.0	810.2	4,767
6	68.3	63.2	240.7	477.9	411.4	5,000
7	69.3	64.1	261.5	261.5	203.2	5,000
8	71.1	64.9	292.4	292.4	218.8	5,000
9	73.7	66.1	328.4	328.4	238.5	5,000
10	76.8	67.2	406.9	406.9	279.8	5,000
11	80.2	68.9	583.6	583.6	381.1	5,000
12	83.4	70.6	695.3	0.0	0.0	4,301
13	85.8	71.5	664.3	0.0	0.0	3,633
14	87.5	72.5	698.6	0.0	0.0	2,931
15	88.1	72.7	727.3	0.0	0.0	2,202
16	87.5	71.7	794.2	0.0	0.0	1,406
17	86.0	70.6	806.4	0.0	0.0	598
18	83.8	69.7	758.7	758.7	494.2	598
19	81.2	68.5	598.2	598.2	387.8	598
20	78.6	68.7	545.2	545.2	358.5	598
21	76.4	68.8	454.4	454.4	309.5	598
22	74.3	67.6	321.1	321.1	239.2	598
23	72.7	66.4	220.8	220.8	191.0	598
24	71.5	65.3	194.9	194.9	177.7	598

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	145.1	885.0	828.4	1,338	150.5	885.0	828.4	2,347
2	68.2	63.5	116.3	885.0	816.2	2,105	115.6	885.0	816.2	3,114
3	66.6	62.2	88.4	885.0	807.6	2,900	88.6	885.0	807.6	3,908
4	65.4	61.1	72.4	885.0	800.6	3,710	72.3	885.0	800.6	4,718
5	64.6	60.7	101.2	885.0	798.1	4,491	101.5	387.6	332.9	5,000
6	64.4	60.7	175.6	687.8	586.7	5,000	175.5	175.5	160.7	5,000
7	64.9	61.2	173.0	173.0	160.7	5,000	173.0	173.0	160.7	5,000
8	66.3	61.6	179.8	179.8	164.1	5,000	180.0	180.0	164.2	5,000
9	68.5	62.5	178.1	178.1	165.2	5,000	178.0	178.0	165.2	5,000
10	71.4	63.6	250.5	250.5	197.3	5,000	250.6	250.6	197.4	5,000
11	74.5	65.1	396.0	396.0	267.7	5,000	396.0	396.0	267.7	5,000
12	77.6	66.8	504.8	0.0	0.0	4,491	504.8	0.0	0.0	4,491
13	80.5	68.2	495.1	0.0	0.0	3,993	495.1	0.0	0.0	3,993

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	0.0	0.0	3,464	525.9	0.0	0.0	3,464
15	84.2	70.7	562.3	0.0	0.0	2,898	562.3	0.0	0.0	2,898
16	84.6	70.5	612.6	0.0	0.0	2,283	612.6	0.0	0.0	2,283
17	84.4	70.4	668.2	0.0	0.0	1,613	668.2	0.0	0.0	1,613
18	83.6	70.7	640.3	640.3	422.7	1,613	640.3	640.3	422.7	1,613
19	82.4	70.7	496.1	496.1	338.9	1,613	496.1	496.1	338.9	1,613
20	80.8	71.9	476.3	476.3	332.4	1,613	476.3	476.3	332.4	1,613
21	78.9	72.4	433.7	433.7	310.8	1,613	433.7	433.7	310.8	1,613
22	76.8	71.1	330.5	330.5	253.4	1,613	330.5	330.5	253.4	1,613
23	74.5	69.3	243.3	243.3	207.5	1,613	243.3	243.3	207.5	1,613
24	72.2	67.2	198.3	198.3	183.1	1,613	198.3	198.3	183.1	1,613

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	70.1	65.3	150.5	885.0	828.4	2,347	150.5	885.0	828.4	2,347
2	68.2	63.5	115.6	885.0	816.2	3,114	115.6	885.0	816.2	3,114
3	66.6	62.2	88.6	885.0	807.6	3,908	88.6	885.0	807.6	3,908
4	65.4	61.1	72.3	885.0	800.6	4,718	72.3	885.0	800.6	4,718
5	64.6	60.7	101.5	387.6	333.0	5,000	101.5	387.6	333.0	5,000
6	64.4	60.7	175.5	175.5	160.7	5,000	175.5	175.5	160.7	5,000
7	64.9	61.2	173.0	173.0	160.7	5,000	173.0	173.0	160.7	5,000
8	66.3	61.6	180.0	180.0	164.2	5,000	180.0	180.0	164.2	5,000
9	68.5	62.5	178.0	178.0	165.2	5,000	178.0	178.0	165.2	5,000
10	71.4	63.6	250.6	250.6	197.4	5,000	250.6	250.6	197.4	5,000
11	74.5	65.1	396.0	396.0	267.7	5,000	396.0	396.0	267.7	5,000
12	77.6	66.8	504.8	0.0	0.0	4,491	504.8	0.0	0.0	4,491
13	80.5	68.2	495.1	0.0	0.0	3,993	495.1	0.0	0.0	3,993
14	82.7	69.7	525.9	0.0	0.0	3,464	525.9	0.0	0.0	3,464
15	84.2	70.7	562.3	0.0	0.0	2,898	562.3	0.0	0.0	2,898
16	84.6	70.5	612.6	0.0	0.0	2,283	612.6	0.0	0.0	2,283
17	84.4	70.4	668.2	0.0	0.0	1,613	668.2	0.0	0.0	1,613
18	83.6	70.7	640.3	640.3	422.7	1,613	640.3	640.3	422.7	1,613
19	82.4	70.7	496.1	496.1	338.9	1,613	496.1	496.1	338.9	1,613
20	80.8	71.9	476.3	476.3	332.4	1,613	476.3	476.3	332.4	1,613
21	78.9	72.4	433.7	433.7	310.8	1,613	433.7	433.7	310.8	1,613
22	76.8	71.1	330.5	330.5	253.4	1,613	330.5	330.5	253.4	1,613
23	74.5	69.3	243.3	243.3	207.5	1,613	243.3	243.3	207.5	1,613
24	72.2	67.2	198.3	198.3	183.1	1,613	198.3	198.3	183.1	1,613

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

Hour	Design DADB (F)	Design DAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	76.6	885.0	798.1	2,421
2	63.3	59.8	60.2	885.0	792.6	3,243
3	62.4	59.2	48.1	885.0	789.0	4,078
4	61.8	58.5	35.4	885.0	784.9	4,924
5	61.6	58.3	42.2	122.1	166.6	5,000
6	62.0	58.7	54.3	54.3	64.5	5,000
7	63.1	59.8	142.1	142.1	146.6	5,000
8	64.9	61.3	146.5	146.5	151.0	5,000
9	67.5	62.3	207.6	207.6	176.6	5,000
10	70.6	63.4	305.6	305.6	220.8	5,000
11	74.0	65.1	491.7	491.7	315.7	5,000
12	77.3	66.6	611.3	0.0	0.0	4,385
13	79.7	68.1	579.7	0.0	0.0	3,801
14	81.3	68.9	596.3	0.0	0.0	3,202
15	81.9	69.3	623.8	0.0	0.0	2,576
16	81.3	68.8	684.1	0.0	0.0	1,890
17	79.9	68.2	694.6	0.0	0.0	1,194
18	77.7	67.0	653.5	653.5	414.3	1,194
19	75.0	66.9	506.2	506.2	330.1	1,194
20	72.4	66.6	369.5	369.5	259.5	1,194
21	70.2	65.3	283.2	283.2	215.8	1,194
22	68.1	63.7	169.8	169.8	164.3	1,194
23	66.5	62.5	112.6	112.6	138.7	1,194
24	65.3	61.6	96.5	96.5	117.8	1,194

Hour	Typical DADB (F)	Typical DAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	68.5	885.0	803.2	2,009	74.8	885.0	803.2	2,973
2	62.0	59.7	47.6	885.0	792.0	2,845	46.1	885.0	792.0	3,808
3	60.4	58.4	26.6	885.0	784.3	3,701	26.6	885.0	784.3	4,663
4	59.2	57.1	15.4	885.0	777.0	4,568	15.4	356.0	308.3	5,000
5	58.4	56.3	19.2	455.2	378.5	5,000	19.2	0.0	0.0	5,000
6	58.2	56.1	24.3	24.3	28.9	5,000	24.3	24.3	28.9	5,000
7	58.7	56.7	8.4	0.0	0.0	5,000	8.4	0.0	0.0	5,000
8	60.1	57.9	87.6	87.6	104.0	5,000	87.6	87.6	104.0	5,000
9	62.4	58.6	79.2	79.2	94.1	5,000	79.2	79.2	94.1	5,000
10	65.2	59.6	142.2	142.2	146.6	5,000	142.9	142.9	146.8	5,000
11	68.3	61.1	275.3	275.3	201.8	5,000	275.3	275.3	201.8	5,000
12	71.5	62.7	415.0	0.0	0.0	4,581	415.0	0.0	0.0	4,581
13	74.3	64.6	413.9	0.0	0.0	4,163	414.3	0.0	0.0	4,163

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

			Weekday				Saturday			
Hour	Typical OADB (F)	Typical OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	0.0	0.0	3,703	456.6	0.0	0.0	3,703
15	78.0	67.1	465.5	0.0	0.0	3,235	465.5	0.0	0.0	3,235
16	78.5	67.5	514.5	0.0	0.0	2,718	514.5	0.0	0.0	2,718
17	78.2	67.9	550.9	0.0	0.0	2,165	550.9	0.0	0.0	2,165
18	77.5	68.0	499.0	499.0	330.4	2,165	499.0	499.0	330.4	2,165
19	76.3	69.3	379.7	379.7	272.7	2,165	379.7	379.7	272.7	2,165
20	74.7	70.0	348.0	348.0	259.0	2,165	348.0	348.0	259.0	2,165
21	72.7	69.0	290.0	290.0	228.3	2,165	290.0	290.0	228.3	2,165
22	70.6	67.3	190.0	190.0	179.8	2,165	190.0	190.0	179.8	2,165
23	68.3	65.4	121.4	121.4	149.0	2,165	121.4	121.4	149.0	2,165
24	66.1	63.6	104.2	104.2	130.2	2,165	104.2	104.2	130.2	2,165

			Sunday				Monday			
Hour	Typical OADB (F)	Typical OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	74.8	885.0	803.2	2,973	74.8	885.0	803.2	2,973
2	62.0	59.7	48.1	885.0	792.0	3,808	48.1	885.0	792.0	3,808
3	60.4	58.4	26.6	885.0	784.3	4,663	26.6	885.0	784.3	4,663
4	59.2	57.1	15.4	356.3	308.6	5,000	15.4	356.3	308.6	5,000
5	58.4	56.3	19.2	0.0	0.0	5,000	19.2	0.0	0.0	5,000
6	58.2	56.1	24.3	24.3	28.9	5,000	24.3	24.3	28.9	5,000
7	58.7	56.7	8.4	0.0	0.0	5,000	8.4	0.0	0.0	5,000
8	60.1	57.9	87.6	87.6	104.0	5,000	87.6	87.6	104.0	5,000
9	62.4	58.6	79.2	79.2	94.1	5,000	79.2	79.2	94.1	5,000
10	65.2	59.6	142.9	142.9	146.8	5,000	142.9	142.9	146.8	5,000
11	68.3	61.1	275.3	275.3	201.8	5,000	275.3	275.3	201.8	5,000
12	71.5	62.7	415.0	0.0	0.0	4,581	415.0	0.0	0.0	4,581
13	74.3	64.6	414.3	0.0	0.0	4,163	414.3	0.0	0.0	4,163
14	76.6	66.0	456.6	0.0	0.0	3,703	456.6	0.0	0.0	3,703
15	78.0	67.1	465.5	0.0	0.0	3,235	465.5	0.0	0.0	3,235
16	78.5	67.5	514.5	0.0	0.0	2,718	514.5	0.0	0.0	2,718
17	78.2	67.9	550.9	0.0	0.0	2,165	550.9	0.0	0.0	2,165
18	77.5	68.0	499.0	499.0	330.4	2,165	499.0	499.0	330.4	2,165
19	76.3	69.3	379.7	379.7	272.7	2,165	379.7	379.7	272.7	2,165
20	74.7	70.0	348.0	348.0	259.0	2,165	348.0	348.0	259.0	2,165
21	72.7	69.0	290.0	290.0	228.3	2,165	290.0	290.0	228.3	2,165
22	70.6	67.3	190.0	190.0	179.8	2,165	190.0	190.0	179.8	2,165
23	68.3	65.4	121.4	121.4	149.0	2,165	121.4	121.4	149.0	2,165
24	66.1	63.6	104.2	104.2	130.2	2,165	104.2	104.2	130.2	2,165

ECO IH-3

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	2,400
2	67.8	64.4	0.0	0.0	0.0	2,400
3	67.0	63.5	0.0	0.0	0.0	2,400
4	66.4	62.7	0.0	0.0	0.0	2,400
5	66.3	62.7	0.0	0.0	0.0	2,400
6	66.6	63.7	0.0	0.0	0.0	2,400
7	67.6	64.5	0.0	0.0	0.0	2,400
8	69.3	65.1	0.0	0.0	0.0	2,400
9	71.8	66.0	65.3	65.3	81.3	2,400
10	74.6	67.6	109.2	109.2	100.6	2,400
11	77.8	69.8	241.8	241.8	167.4	2,400
12	80.9	71.9	384.5	384.5	255.7	2,400
13	83.2	73.5	353.7	353.7	240.4	2,400
14	84.7	74.4	435.0	435.0	296.8	2,400
15	85.3	74.6	542.1	542.1	381.2	2,400
16	84.7	74.5	682.4	625.0	453.2	2,343
17	83.4	73.5	806.8	625.0	449.4	2,161
18	81.3	71.5	768.0	625.0	442.0	2,018
19	78.8	70.1	652.3	625.0	437.0	1,991
20	76.3	70.0	591.1	591.1	407.2	1,991
21	74.2	69.5	546.4	480.0	465.5	1,923
22	72.3	68.7	422.4	480.0	462.3	1,979
23	70.8	67.1	246.2	480.0	456.1	2,211
24	69.7	65.8	170.5	361.5	321.7	2,400

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	119.5	119.5	102.3	2,400	125.9	125.9	105.0	2,400
2	66.0	63.9	103.2	103.2	93.9	2,400	102.7	102.7	93.7	2,400
3	64.6	62.4	79.4	79.4	83.1	2,400	79.5	79.5	83.1	2,400
4	63.7	61.3	65.3	65.3	76.8	2,400	65.3	65.3	76.8	2,400
5	63.0	60.8	69.4	69.4	77.8	2,400	69.4	69.4	77.8	2,400
6	62.8	61.2	153.4	153.4	111.4	2,400	153.5	153.5	111.4	2,400
7	63.4	61.7	195.5	195.5	130.6	2,400	195.5	195.5	130.6	2,400
8	65.1	62.3	185.3	185.3	126.9	2,400	185.6	185.6	127.1	2,400
9	67.6	63.3	220.8	220.8	145.1	2,400	220.8	220.8	145.1	2,400
10	70.7	65.2	286.9	286.9	182.1	2,400	286.9	286.9	182.1	2,400
11	74.0	67.5	432.3	432.3	276.9	2,400	432.3	432.3	276.9	2,400
12	77.1	69.8	557.6	557.6	378.5	2,400	557.6	557.6	378.5	2,400
13	79.6	71.6	535.2	535.2	365.9	2,400	535.2	535.2	365.9	2,400

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	534.2	368.5	2,400	534.2	534.2	368.5	2,400
15	81.8	72.8	561.4	561.4	391.4	2,400	561.4	561.4	391.4	2,400
16	81.6	73.1	609.6	609.6	434.2	2,400	609.6	609.6	434.2	2,400
17	81.0	72.7	678.8	625.0	446.4	2,346	678.8	625.0	446.4	2,346
18	80.0	71.6	665.1	625.0	442.4	2,306	665.1	625.0	442.4	2,306
19	78.7	71.3	542.0	542.0	370.5	2,306	542.0	542.0	370.5	2,306
20	77.1	72.0	496.4	496.4	336.3	2,306	496.4	496.4	336.3	2,306
21	75.3	71.8	448.1	480.0	474.9	2,336	448.1	480.0	474.9	2,336
22	73.3	71.0	338.5	404.0	383.0	2,400	338.5	404.0	383.0	2,400
23	71.3	68.9	227.4	227.4	158.2	2,400	227.4	227.4	158.2	2,400
24	69.4	66.8	158.1	158.1	121.2	2,400	158.1	158.1	121.2	2,400

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	125.9	125.9	105.0	2,400	125.9	125.9	105.0	2,400
2	66.0	63.9	102.7	102.7	93.7	2,400	102.7	102.7	93.7	2,400
3	64.6	62.4	79.5	79.5	83.1	2,400	79.5	79.5	83.1	2,400
4	63.7	61.3	65.3	65.3	76.8	2,400	65.3	65.3	76.8	2,400
5	63.0	60.8	69.4	69.4	77.8	2,400	69.4	69.4	77.8	2,400
6	62.8	61.2	153.5	153.5	111.4	2,400	153.5	153.5	111.4	2,400
7	63.4	61.7	195.5	195.5	130.6	2,400	195.5	195.5	130.6	2,400
8	65.1	62.3	185.6	185.6	127.1	2,400	185.6	185.6	127.1	2,400
9	67.6	63.3	220.8	220.8	145.1	2,400	220.8	220.8	145.1	2,400
10	70.7	65.2	286.9	286.9	182.1	2,400	286.9	286.9	182.1	2,400
11	74.0	67.5	432.3	432.3	276.9	2,400	432.3	432.3	276.9	2,400
12	77.1	69.8	557.6	557.6	378.5	2,400	557.6	557.6	378.5	2,400
13	79.6	71.6	535.2	535.2	365.9	2,400	535.2	535.2	365.9	2,400
14	81.3	72.7	534.2	534.2	368.5	2,400	534.2	534.2	368.5	2,400
15	81.8	72.8	561.4	561.4	391.4	2,400	561.4	561.4	391.4	2,400
16	81.6	73.1	609.6	609.6	434.2	2,400	609.6	609.6	434.2	2,400
17	81.0	72.7	678.8	625.0	446.4	2,346	678.8	625.0	446.4	2,346
18	80.0	71.6	665.1	625.0	442.4	2,306	665.1	625.0	442.4	2,306
19	78.7	71.3	542.0	542.0	370.5	2,306	542.0	542.0	370.5	2,306
20	77.1	72.0	496.4	496.4	336.3	2,306	496.4	496.4	336.3	2,306
21	75.3	71.8	448.1	480.0	474.9	2,336	448.1	480.0	474.9	2,336
22	73.3	71.0	338.5	404.0	383.0	2,400	338.5	404.0	383.0	2,400
23	71.3	68.9	227.4	227.4	158.2	2,400	227.4	227.4	158.2	2,400
24	69.4	66.8	158.1	158.1	121.2	2,400	158.1	158.1	121.2	2,400

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	258.3	258.3	174.2	2,400
2	72.3	67.9	206.7	206.7	146.1	2,400
3	71.4	67.2	185.6	185.6	134.7	2,400
4	70.7	67.0	180.9	180.9	132.1	2,400
5	70.5	66.9	252.9	252.9	167.7	2,400
6	71.0	67.4	326.9	326.9	209.2	2,400
7	72.1	68.4	380.7	380.7	244.4	2,400
8	74.1	69.3	401.4	401.4	260.2	2,400
9	77.0	70.1	420.6	420.6	275.3	2,400
10	80.4	71.4	494.4	494.4	333.0	2,400
11	84.2	73.3	672.3	625.0	448.7	2,353
12	87.8	75.5	775.6	625.0	457.0	2,202
13	90.5	76.5	733.0	625.0	460.9	2,094
14	92.3	76.8	763.3	625.0	462.1	1,956
15	93.0	77.0	805.4	625.0	462.9	1,775
16	92.3	76.7	891.8	625.0	461.7	1,509
17	90.8	75.3	889.6	625.0	456.3	1,244
18	88.3	74.2	860.2	625.0	452.1	1,009
19	85.4	72.9	714.1	625.0	447.2	920
20	82.4	73.4	680.5	625.0	449.1	864
21	80.0	73.0	641.2	480.0	479.9	702
22	77.7	72.3	559.5	480.0	477.0	622
23	75.9	70.6	426.3	480.0	470.0	676
24	74.6	69.4	280.2	480.0	465.1	875

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	259.7	480.0	471.6	1,094	265.3	480.0	471.6	1,936
2	71.9	68.8	219.9	480.0	462.7	1,354	214.6	480.0	462.7	2,200
3	69.9	67.0	167.1	480.0	455.7	1,665	167.3	369.2	333.0	2,400
4	68.3	65.9	152.3	480.0	451.5	1,992	152.7	152.7	117.5	2,400
5	67.4	65.2	203.0	480.0	448.8	2,267	203.1	203.1	139.8	2,400
6	67.0	64.9	256.9	391.5	349.4	2,400	256.9	256.9	165.9	2,400
7	67.5	65.3	274.1	274.1	175.6	2,400	274.2	274.2	175.6	2,400
8	68.8	65.6	262.6	262.6	170.2	2,400	262.6	262.6	170.2	2,400
9	70.9	65.7	248.7	248.7	163.2	2,400	248.7	248.7	163.2	2,400
10	73.6	66.5	305.3	305.3	194.9	2,400	305.3	305.3	194.9	2,400
11	76.7	67.9	454.0	454.0	293.2	2,400	454.0	454.0	293.2	2,400
12	79.9	69.9	581.5	581.5	398.8	2,400	581.5	581.5	398.8	2,400
13	83.0	71.3	563.2	563.2	388.0	2,400	563.2	563.2	388.0	2,400

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	597.7	421.5	2,400	597.7	597.7	421.5	2,400
15	87.8	73.9	654.3	625.0	450.9	2,371	654.3	625.0	450.9	2,371
16	89.1	75.3	737.3	625.0	456.3	2,258	737.3	625.0	456.3	2,258
17	89.5	75.5	810.6	625.0	457.0	2,073	810.6	625.0	457.0	2,073
18	89.2	76.2	803.8	625.0	459.7	1,894	803.8	625.0	459.7	1,894
19	88.3	76.7	700.3	625.0	461.7	1,819	700.3	625.0	461.7	1,819
20	86.7	78.6	684.0	625.0	469.2	1,760	684.0	625.0	469.2	1,760
21	84.7	78.8	656.5	480.0	504.8	1,582	656.5	480.0	504.8	1,582
22	82.3	78.0	549.7	480.0	501.3	1,511	549.7	480.0	501.3	1,511
23	79.6	75.4	419.7	480.0	490.0	1,570	419.7	480.0	490.0	1,570
24	76.9	73.0	325.9	480.0	479.9	1,723	325.9	480.0	479.9	1,723

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	74.3	71.0	265.3	480.0	471.6	1,936	265.3	480.0	471.6	1,936
2	71.9	68.8	214.6	480.0	462.7	2,200	214.6	480.0	462.7	2,200
3	69.9	67.0	167.3	369.2	333.0	2,400	167.3	369.2	333.0	2,400
4	68.3	65.9	152.7	152.7	117.5	2,400	152.7	152.7	117.5	2,400
5	67.4	65.2	203.1	203.1	139.8	2,400	203.1	203.1	139.8	2,400
6	67.0	64.9	256.9	256.9	165.9	2,400	256.9	256.9	165.9	2,400
7	67.5	65.3	274.2	274.2	175.6	2,400	274.2	274.2	175.6	2,400
8	68.8	65.6	262.6	262.6	170.2	2,400	262.6	262.6	170.2	2,400
9	70.9	65.7	248.7	248.7	163.2	2,400	248.7	248.7	163.2	2,400
10	73.6	66.5	305.3	305.3	194.9	2,400	305.3	305.3	194.9	2,400
11	76.7	67.9	454.0	454.0	293.2	2,400	454.0	454.0	293.2	2,400
12	79.9	69.9	581.5	581.5	398.8	2,400	581.5	581.5	398.8	2,400
13	83.0	71.3	563.2	563.2	388.0	2,400	563.2	563.2	388.0	2,400
14	85.7	72.5	597.7	597.7	421.5	2,400	597.7	597.7	421.5	2,400
15	87.8	73.9	654.3	625.0	450.9	2,371	654.3	625.0	450.9	2,371
16	89.1	75.3	737.3	625.0	456.3	2,258	737.3	625.0	456.3	2,258
17	89.5	75.5	810.6	625.0	457.0	2,073	810.6	625.0	457.0	2,073
18	89.2	76.2	803.8	625.0	459.7	1,894	803.8	625.0	459.7	1,894
19	88.3	76.7	700.3	625.0	461.7	1,819	700.3	625.0	461.7	1,819
20	86.7	78.6	684.0	625.0	469.2	1,760	684.0	625.0	469.2	1,760
21	84.7	78.8	656.5	480.0	504.8	1,582	656.5	480.0	504.8	1,582
22	82.3	78.0	549.7	480.0	501.3	1,511	549.7	480.0	501.3	1,511
23	79.6	75.4	419.7	480.0	490.0	1,570	419.7	480.0	490.0	1,570
24	76.9	73.0	325.9	480.0	479.9	1,723	325.9	480.0	479.9	1,723

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

	Design		Design			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.5	64.5	164.0	480.0	446.2	2,037
2	69.5	63.5	133.5	480.0	442.6	2,382
3	68.7	63.0	120.1	139.7	137.7	2,400
4	68.1	62.4	107.0	107.0	93.7	2,400
5	67.9	62.6	162.3	162.3	117.2	2,400
6	68.3	63.2	240.7	240.7	154.5	2,400
7	69.3	64.1	261.5	261.5	166.6	2,400
8	71.1	64.9	292.4	292.4	184.4	2,400
9	73.7	66.1	328.4	328.4	207.1	2,400
10	76.8	67.2	406.9	406.9	258.9	2,400
11	80.2	68.9	583.6	583.6	397.2	2,400
12	83.4	70.6	695.3	625.0	438.8	2,330
13	85.8	71.5	664.3	625.0	442.0	2,290
14	87.5	72.5	698.6	625.0	445.7	2,217
15	88.1	72.7	727.3	625.0	446.4	2,114
16	87.5	71.7	794.2	625.0	442.8	1,945
17	86.0	70.6	806.4	625.0	438.8	1,764
18	83.8	69.7	758.7	625.0	435.6	1,630
19	81.2	68.5	598.2	598.2	408.3	1,630
20	78.6	68.7	545.2	545.2	365.0	1,630
21	76.4	68.8	454.4	480.0	462.7	1,654
22	74.3	67.6	321.1	480.0	458.0	1,812
23	72.7	66.4	220.8	480.0	453.4	2,070
24	71.5	65.3	194.9	480.0	449.2	2,353

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	145.1	193.8	178.9	2,400	150.5	150.5	115.7	2,400
2	68.2	63.5	116.3	116.3	98.8	2,400	115.6	115.6	98.5	2,400
3	66.6	62.2	88.4	88.4	86.3	2,400	88.6	88.6	86.3	2,400
4	65.4	61.1	72.4	72.4	79.2	2,400	72.3	72.3	79.2	2,400
5	64.6	60.7	101.2	101.2	89.5	2,400	101.5	101.5	89.7	2,400
6	64.4	60.7	175.6	175.6	120.2	2,400	175.5	175.5	120.2	2,400
7	64.9	61.2	173.0	173.0	119.8	2,400	173.0	173.0	119.9	2,400
8	66.3	61.6	179.8	179.8	123.4	2,400	180.0	180.0	123.5	2,400
9	68.5	62.5	178.1	178.1	124.0	2,400	178.0	178.0	124.0	2,400
10	71.4	63.6	250.5	250.5	160.1	2,400	250.6	250.6	160.2	2,400
11	74.5	65.1	396.0	396.0	246.8	2,400	396.0	396.0	246.8	2,400
12	77.6	66.8	504.8	504.8	327.7	2,400	504.8	504.8	327.7	2,400
13	80.5	68.2	495.1	495.1	324.3	2,400	495.1	495.1	324.3	2,400

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	525.9	352.5	2,400	525.9	525.9	352.5	2,400
15	84.2	70.7	562.3	562.3	385.3	2,400	562.3	562.3	385.3	2,400
16	84.6	70.5	612.6	612.6	427.5	2,400	612.6	612.6	427.5	2,400
17	84.4	70.4	668.2	625.0	438.1	2,357	668.2	625.0	438.1	2,357
18	83.6	70.7	640.3	625.0	439.1	2,342	640.3	625.0	439.1	2,342
19	82.4	70.7	496.1	496.1	332.2	2,342	496.1	496.1	332.2	2,342
20	80.8	71.9	476.3	476.3	320.5	2,342	476.3	476.3	320.5	2,342
21	78.9	72.4	433.7	480.0	477.4	2,386	433.7	480.0	477.4	2,386
22	76.8	71.1	330.5	346.5	323.6	2,400	330.5	346.5	323.6	2,400
23	74.5	69.3	243.3	243.3	167.2	2,400	243.3	243.3	167.2	2,400
24	72.2	67.2	198.3	198.3	140.8	2,400	198.3	198.3	140.8	2,400

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	150.5	150.5	115.7	2,400	150.5	150.5	115.7	2,400
2	68.2	63.5	115.6	115.6	98.5	2,400	115.6	115.6	98.5	2,400
3	66.6	62.2	88.6	88.6	86.3	2,400	88.6	88.6	86.3	2,400
4	65.4	61.1	72.3	72.3	79.2	2,400	72.3	72.3	79.2	2,400
5	64.6	60.7	101.5	101.5	89.7	2,400	101.5	101.5	89.7	2,400
6	64.4	60.7	175.5	175.5	120.2	2,400	175.5	175.5	120.2	2,400
7	64.9	61.2	173.0	173.0	119.9	2,400	173.0	173.0	119.9	2,400
8	66.3	61.6	180.0	180.0	123.5	2,400	180.0	180.0	123.5	2,400
9	68.5	62.5	178.0	178.0	124.0	2,400	178.0	178.0	124.0	2,400
10	71.4	63.6	250.6	250.6	160.2	2,400	250.6	250.6	160.2	2,400
11	74.5	65.1	396.0	396.0	246.8	2,400	396.0	396.0	246.8	2,400
12	77.6	66.8	504.8	504.8	327.7	2,400	504.8	504.8	327.7	2,400
13	80.5	68.2	495.1	495.1	324.3	2,400	495.1	495.1	324.3	2,400
14	82.7	69.7	525.9	525.9	352.5	2,400	525.9	525.9	352.5	2,400
15	84.2	70.7	562.3	562.3	385.3	2,400	562.3	562.3	385.3	2,400
16	84.6	70.5	612.6	612.6	427.5	2,400	612.6	612.6	427.5	2,400
17	84.4	70.4	668.2	625.0	438.1	2,357	668.2	625.0	438.1	2,357
18	83.6	70.7	640.3	625.0	439.1	2,342	640.3	625.0	439.1	2,342
19	82.4	70.7	496.1	496.1	332.2	2,342	496.1	496.1	332.2	2,342
20	80.8	71.9	476.3	476.3	320.5	2,342	476.3	476.3	320.5	2,342
21	78.9	72.4	433.7	480.0	477.4	2,386	433.7	480.0	477.4	2,386
22	76.8	71.1	330.5	346.5	323.6	2,400	330.5	346.5	323.6	2,400
23	74.5	69.3	243.3	243.3	167.2	2,400	243.3	243.3	167.2	2,400
24	72.2	67.2	198.3	198.3	140.8	2,400	198.3	198.3	140.8	2,400

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	76.6	76.6	80.3	2,400
2	63.3	59.8	60.2	60.2	71.7	2,400
3	62.4	59.2	48.1	48.1	57.2	2,400
4	61.8	58.5	35.4	35.4	42.0	2,400
5	61.6	58.3	42.2	42.2	50.2	2,400
6	62.0	58.7	54.3	54.3	64.5	2,400
7	63.1	59.8	142.1	142.1	105.1	2,400
8	64.9	61.3	146.5	146.5	108.6	2,400
9	67.5	62.3	207.6	207.6	137.2	2,400
10	70.6	63.4	305.6	305.6	189.8	2,400
11	74.0	65.1	491.7	491.7	313.3	2,400
12	77.3	66.6	611.3	611.3	413.2	2,400
13	79.7	68.1	579.7	579.7	391.3	2,400
14	81.3	68.9	596.3	596.3	408.0	2,400
15	81.9	69.3	623.8	623.8	433.1	2,400
16	81.3	68.8	684.1	625.0	432.4	2,341
17	79.9	68.2	694.6	625.0	430.3	2,271
18	77.7	67.0	653.5	625.0	426.3	2,243
19	75.0	66.9	506.2	506.2	329.1	2,243
20	72.4	66.6	369.5	369.5	233.2	2,243
21	70.2	65.3	283.2	442.2	405.4	2,400
22	68.1	63.7	169.8	169.8	122.1	2,400
23	66.5	62.5	112.6	112.6	96.1	2,400
24	65.3	61.6	96.5	96.5	88.7	2,400

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	68.5	68.5	78.2	2,400	74.8	74.8	80.5	2,400
2	62.0	59.7	47.6	47.6	56.7	2,400	48.1	48.1	57.3	2,400
3	60.4	58.4	26.6	26.6	31.6	2,400	26.6	26.6	31.6	2,400
4	59.2	57.1	15.4	15.4	18.3	2,400	15.4	15.4	18.3	2,400
5	58.4	56.3	19.2	19.2	22.8	2,400	19.2	19.2	22.8	2,400
6	58.2	56.1	24.3	24.3	28.9	2,400	24.3	24.3	28.9	2,400
7	58.7	56.7	8.4	0.0	0.0	2,400	8.4	0.0	0.0	2,400
8	60.1	57.9	87.6	87.6	83.5	2,400	87.6	87.6	83.5	2,400
9	62.4	58.6	79.2	79.2	80.4	2,400	79.2	79.2	80.4	2,400
10	65.2	59.6	142.2	142.2	105.1	2,400	142.9	142.9	105.4	2,400
11	68.3	61.1	275.3	275.3	168.2	2,400	275.3	275.3	168.2	2,400
12	71.5	62.7	415.0	415.0	253.7	2,400	415.0	415.0	253.8	2,400
13	74.3	64.6	413.9	413.9	257.4	2,400	414.3	414.3	257.6	2,400

COLD THERMAL STORAGE - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	456.6	290.2	2,400	456.6	456.6	290.1	2,400
15	78.0	67.1	465.5	465.5	299.4	2,400	465.5	465.5	299.4	2,400
16	78.5	67.5	514.5	514.5	337.2	2,400	514.5	514.5	337.2	2,400
17	78.2	67.9	550.9	550.9	367.1	2,400	550.9	550.9	367.1	2,400
18	77.5	68.0	499.0	499.0	326.7	2,400	499.0	499.0	326.7	2,400
19	76.3	69.3	379.7	379.7	245.9	2,400	379.7	379.7	245.9	2,400
20	74.7	70.0	348.0	348.0	228.0	2,400	348.0	348.0	228.0	2,400
21	72.7	69.0	290.0	290.0	192.0	2,400	290.0	290.0	192.0	2,400
22	70.6	67.3	190.0	190.0	136.9	2,400	190.0	190.0	136.9	2,400
23	68.3	65.4	121.4	121.4	103.2	2,400	121.4	121.4	103.2	2,400
24	66.1	63.6	104.2	104.2	93.9	2,400	104.2	104.2	93.9	2,400

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	74.8	74.8	80.5	2,400	74.8	74.8	80.5	2,400
2	62.0	59.7	48.1	48.1	57.3	2,400	48.1	48.1	57.3	2,400
3	60.4	58.4	26.6	26.6	31.6	2,400	26.6	26.6	31.6	2,400
4	59.2	57.1	15.4	15.4	18.3	2,400	15.4	15.4	18.3	2,400
5	58.4	56.3	19.2	19.2	22.8	2,400	19.2	19.2	22.8	2,400
6	58.2	56.1	24.3	24.3	28.9	2,400	24.3	24.3	28.9	2,400
7	58.7	56.7	8.4	0.0	0.0	2,400	8.4	0.0	0.0	2,400
8	60.1	57.9	87.6	87.6	83.5	2,400	87.6	87.6	83.5	2,400
9	62.4	58.6	79.2	79.2	80.4	2,400	79.2	79.2	80.4	2,400
10	65.2	59.6	142.9	142.9	105.4	2,400	142.9	142.9	105.4	2,400
11	68.3	61.1	275.3	275.3	168.2	2,400	275.3	275.3	168.2	2,400
12	71.5	62.7	415.0	415.0	253.8	2,400	415.0	415.0	253.8	2,400
13	74.3	64.6	414.3	414.3	257.6	2,400	414.3	414.3	257.6	2,400
14	76.6	66.0	456.6	456.6	290.1	2,400	456.6	456.6	290.1	2,400
15	78.0	67.1	465.5	465.5	299.4	2,400	465.5	465.5	299.4	2,400
16	78.5	67.5	514.5	514.5	337.2	2,400	514.5	514.5	337.2	2,400
17	78.2	67.9	550.9	550.9	367.1	2,400	550.9	550.9	367.1	2,400
18	77.5	68.0	499.0	499.0	326.7	2,400	499.0	499.0	326.7	2,400
19	76.3	69.3	379.7	379.7	245.9	2,400	379.7	379.7	245.9	2,400
20	74.7	70.0	348.0	348.0	228.0	2,400	348.0	348.0	228.0	2,400
21	72.7	69.0	290.0	290.0	192.0	2,400	290.0	290.0	192.0	2,400
22	70.6	67.3	190.0	190.0	136.9	2,400	190.0	190.0	136.9	2,400
23	68.3	65.4	121.4	121.4	103.2	2,400	121.4	121.4	103.2	2,400
24	66.1	63.6	104.2	104.2	93.9	2,400	104.2	104.2	93.9	2,400

ECO IH-4

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

June

Hour	Design DADB (F)	Design DAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	5,000
2	67.8	64.4	0.0	0.0	0.0	5,000
3	67.0	63.5	0.0	0.0	0.0	5,000
4	66.4	62.7	0.0	0.0	0.0	5,000
5	66.3	62.7	0.0	0.0	0.0	5,000
6	66.6	63.7	0.0	0.0	0.0	5,000
7	67.6	64.5	0.0	0.0	0.0	5,000
8	69.3	65.1	0.0	0.0	0.0	5,000
9	71.8	66.0	65.3	65.3	84.3	5,000
10	74.6	67.6	109.2	109.2	132.0	5,000
11	77.8	69.8	241.8	241.8	193.4	5,000
12	80.9	71.9	384.5	0.0	0.0	4,611
13	83.2	73.5	353.7	0.0	0.0	4,254
14	84.7	74.4	435.0	0.0	0.0	3,816
15	85.3	74.6	542.1	0.0	0.0	3,271
16	84.7	74.5	682.4	0.0	0.0	2,586
17	83.4	73.5	806.8	0.0	0.0	1,777
18	81.3	71.5	768.0	768.0	517.3	1,777
19	78.8	70.1	652.3	652.3	426.8	1,777
20	76.3	70.0	591.1	591.1	385.2	1,777
21	74.2	69.5	546.4	750.0	727.5	1,979
22	72.3	68.7	422.4	750.0	722.5	2,305
23	70.8	67.1	246.2	750.0	712.7	2,807
24	69.7	65.8	170.5	750.0	704.9	3,384

Hour	Typical DADB (F)	Typical DAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	119.5	750.0	702.0	4,012	125.9	750.0	702.0	3,949
2	66.0	63.9	103.2	750.0	693.9	4,655	102.7	750.0	693.9	4,593
3	64.6	62.4	79.4	427.7	364.3	5,000	79.5	490.3	417.9	5,000
4	63.7	61.3	65.3	65.3	79.6	5,000	65.3	65.3	79.6	5,000
5	63.0	60.8	69.4	69.4	84.0	5,000	69.4	69.4	84.0	5,000
6	62.8	61.2	153.4	153.4	138.8	5,000	153.5	153.5	138.9	5,000
7	63.4	61.7	195.5	195.5	156.5	5,000	195.5	195.5	156.5	5,000
8	65.1	62.3	185.3	185.3	153.5	5,000	185.6	185.6	153.6	5,000
9	67.6	63.3	220.8	220.8	170.3	5,000	220.8	220.8	170.3	5,000
10	70.7	65.2	286.9	286.9	204.0	5,000	286.9	286.9	204.0	5,000
11	74.0	67.5	432.3	432.3	283.5	5,000	432.3	432.3	283.5	5,000
12	77.1	69.8	557.6	0.0	0.0	4,438	557.6	0.0	0.0	4,438
13	79.6	71.6	535.2	0.0	0.0	3,900	535.2	0.0	0.0	3,900

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	0.0	0.0	3,362	534.2	0.0	0.0	3,362
15	81.8	72.8	561.4	0.0	0.0	2,798	561.4	0.0	0.0	2,798
16	81.6	73.1	609.6	0.0	0.0	2,186	609.6	0.0	0.0	2,186
17	81.0	72.7	678.8	0.0	0.0	1,506	678.8	0.0	0.0	1,506
18	80.0	71.6	665.1	665.1	441.7	1,506	665.1	665.1	441.7	1,506
19	78.7	71.3	542.0	542.0	360.2	1,506	542.0	542.0	360.2	1,506
20	77.1	72.0	496.4	496.4	335.3	1,506	496.4	496.4	335.3	1,506
21	75.3	71.8	448.1	750.0	742.1	1,807	448.1	750.0	742.1	1,807
22	73.3	71.0	338.5	750.0	737.0	2,217	338.5	750.0	737.0	2,217
23	71.3	68.9	227.4	750.0	723.8	2,738	227.4	750.0	723.8	2,738
24	69.4	66.8	158.1	750.0	710.9	3,327	158.1	750.0	710.9	3,327

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	67.6	65.3	125.9	750.0	702.0	3,949	125.9	750.0	702.0	3,949
2	66.0	63.9	102.7	750.0	693.9	4,593	102.7	750.0	693.9	4,593
3	64.6	62.4	79.5	490.3	417.9	5,000	79.5	490.3	417.9	5,000
4	63.7	61.3	65.3	65.3	79.6	5,000	65.3	65.3	79.6	5,000
5	63.0	60.8	69.4	69.4	84.0	5,000	69.4	69.4	84.0	5,000
6	62.8	61.2	153.5	153.5	138.8	5,000	153.5	153.5	138.8	5,000
7	63.4	61.7	195.5	195.5	156.5	5,000	195.5	195.5	156.5	5,000
8	65.1	62.3	185.6	185.6	153.6	5,000	185.6	185.6	153.6	5,000
9	67.6	63.3	220.8	220.8	170.3	5,000	220.8	220.8	170.3	5,000
10	70.7	65.2	286.9	286.9	204.0	5,000	286.9	286.9	204.0	5,000
11	74.0	67.5	432.3	432.3	283.5	5,000	432.3	432.3	283.5	5,000
12	77.1	69.8	557.6	0.0	0.0	4,438	557.6	0.0	0.0	4,438
13	79.6	71.6	535.2	0.0	0.0	3,900	535.2	0.0	0.0	3,900
14	81.3	72.7	534.2	0.0	0.0	3,362	534.2	0.0	0.0	3,362
15	81.8	72.8	561.4	0.0	0.0	2,798	561.4	0.0	0.0	2,798
16	81.6	73.1	609.6	0.0	0.0	2,186	609.6	0.0	0.0	2,186
17	81.0	72.7	678.8	0.0	0.0	1,506	678.8	0.0	0.0	1,506
18	80.0	71.6	665.1	665.1	441.7	1,506	665.1	665.1	441.7	1,506
19	78.7	71.3	542.0	542.0	360.2	1,506	542.0	542.0	360.2	1,506
20	77.1	72.0	496.4	496.4	335.3	1,506	496.4	496.4	335.3	1,506
21	75.3	71.8	448.1	750.0	742.1	1,807	448.1	750.0	742.1	1,807
22	73.3	71.0	338.5	750.0	737.0	2,217	338.5	750.0	737.0	2,217
23	71.3	68.9	227.4	750.0	723.8	2,738	227.4	750.0	723.8	2,738
24	69.4	66.8	158.1	750.0	710.9	3,327	158.1	750.0	710.9	3,327

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

	Design		Design			
Hour	Design OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	73.4	68.8	258.3	750.0	723.1	3,816
2	72.3	67.9	206.7	750.0	717.6	4,356
3	71.4	67.2	185.6	750.0	713.3	4,917
4	70.7	67.0	180.9	267.4	259.4	5,000
5	70.5	66.9	252.9	252.9	192.2	5,000
6	71.0	67.4	326.9	326.9	228.7	5,000
7	72.1	68.4	380.7	380.7	258.8	5,000
8	74.1	69.3	401.4	401.4	272.5	5,000
9	77.0	70.1	420.6	420.6	285.5	5,000
10	80.4	71.4	494.4	494.4	332.0	5,000
11	84.2	73.3	672.3	672.3	453.8	5,000
12	87.8	75.5	775.6	0.0	0.0	4,220
13	90.5	76.5	733.0	0.0	0.0	3,484
14	92.3	76.8	763.3	0.0	0.0	2,718
15	93.0	77.0	805.4	0.0	0.0	1,910
16	92.3	76.7	891.8	0.0	0.0	1,017
17	90.8	75.3	889.6	0.0	0.0	127
18	88.3	74.2	860.2	860.2	604.9	127
19	85.4	72.9	714.1	714.1	482.7	127
20	82.4	73.4	680.5	680.5	460.1	127
21	80.0	73.0	641.2	750.0	749.9	235
22	77.7	72.3	559.5	750.0	745.3	426
23	75.9	70.6	426.3	750.0	734.4	749
24	74.6	69.4	280.2	750.0	726.9	1,218

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	259.7	750.0	737.0	1,708	265.3	750.0	737.0	2,566
2	71.9	68.8	219.9	750.0	723.1	2,236	214.6	750.0	723.1	3,099
3	69.9	67.0	167.1	750.0	712.1	2,817	167.3	750.0	712.1	3,679
4	68.3	65.9	152.3	750.0	705.5	3,413	152.7	750.0	705.5	4,274
5	67.4	65.2	203.0	750.0	701.4	3,957	203.1	750.0	701.4	4,817
6	67.0	64.9	256.9	750.0	699.7	4,447	256.9	443.6	387.1	5,000
7	67.5	65.3	274.1	750.0	702.0	4,919	274.2	274.2	198.4	5,000
8	68.8	65.6	262.6	347.1	313.3	5,000	262.6	262.6	193.7	5,000
9	70.9	65.7	248.7	248.7	187.6	5,000	248.7	248.7	187.6	5,000
10	73.6	66.5	305.3	305.3	215.9	5,000	305.3	305.3	215.9	5,000
11	76.7	67.9	454.0	454.0	296.6	5,000	454.0	454.0	296.6	5,000
12	79.9	69.9	581.5	0.0	0.0	4,414	581.5	0.0	0.0	4,414
13	83.0	71.3	563.2	0.0	0.0	3,848	563.2	0.0	0.0	3,848

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	0.0	0.0	3,247	597.7	0.0	0.0	3,247
15	87.8	73.9	654.3	0.0	0.0	2,590	654.3	0.0	0.0	2,590
16	89.1	75.3	737.3	0.0	0.0	1,851	737.3	0.0	0.0	1,851
17	89.5	75.5	810.6	0.0	0.0	1,039	810.6	0.0	0.0	1,039
18	89.2	76.2	803.8	803.8	568.1	1,039	803.8	803.8	568.1	1,039
19	88.3	76.7	700.3	700.3	489.9	1,039	700.3	700.3	489.9	1,039
20	86.7	78.6	684.0	684.0	487.6	1,039	684.0	684.0	487.6	1,039
21	84.7	78.8	656.5	750.0	788.8	1,131	656.5	750.0	788.8	1,131
22	82.3	78.0	549.7	750.0	783.3	1,331	549.7	750.0	783.3	1,331
23	79.6	75.4	419.7	750.0	765.7	1,660	419.7	750.0	765.7	1,660
24	76.9	73.0	325.9	750.0	749.9	2,083	325.9	750.0	749.9	2,083

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	265.3	750.0	737.0	2,566	265.3	750.0	737.0	2,566
2	71.9	68.8	214.6	750.0	723.1	3,099	214.6	750.0	723.1	3,099
3	69.9	67.0	167.3	750.0	712.1	3,679	167.3	750.0	712.1	3,679
4	68.3	65.9	152.7	750.0	705.5	4,274	152.7	750.0	705.5	4,274
5	67.4	65.2	203.1	750.0	701.4	4,817	203.1	750.0	701.4	4,817
6	67.0	64.9	256.9	443.6	387.1	5,000	256.9	443.6	387.1	5,000
7	67.5	65.3	274.2	274.2	198.4	5,000	274.2	274.2	198.4	5,000
8	68.8	65.6	262.6	262.6	193.7	5,000	262.6	262.6	193.7	5,000
9	70.9	65.7	248.7	248.7	187.6	5,000	248.7	248.7	187.6	5,000
10	73.6	66.5	305.3	305.3	215.9	5,000	305.3	305.3	215.9	5,000
11	76.7	67.9	454.0	454.0	296.6	5,000	454.0	454.0	296.6	5,000
12	79.9	69.9	581.5	0.0	0.0	4,414	581.5	0.0	0.0	4,414
13	83.0	71.3	563.2	0.0	0.0	3,848	563.2	0.0	0.0	3,848
14	85.7	72.5	597.7	0.0	0.0	3,247	597.7	0.0	0.0	3,247
15	87.8	73.9	654.3	0.0	0.0	2,590	654.3	0.0	0.0	2,590
16	89.1	75.3	737.3	0.0	0.0	1,851	737.3	0.0	0.0	1,851
17	89.5	75.5	810.6	0.0	0.0	1,039	810.6	0.0	0.0	1,039
18	89.2	76.2	803.8	803.8	568.1	1,039	803.8	803.8	568.1	1,039
19	88.3	76.7	700.3	700.3	489.9	1,039	700.3	700.3	489.9	1,039
20	86.7	78.6	684.0	684.0	487.6	1,039	684.0	684.0	487.6	1,039
21	84.7	78.8	656.5	750.0	788.8	1,131	656.5	750.0	788.8	1,131
22	82.3	78.0	549.7	750.0	783.3	1,331	549.7	750.0	783.3	1,331
23	79.6	75.4	419.7	750.0	765.7	1,660	419.7	750.0	765.7	1,660
24	76.9	73.0	325.9	750.0	749.9	2,083	325.9	750.0	749.9	2,083

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

Hour	Design ODDB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	164.0	750.0	697.4	2,667
2	69.5	63.5	133.5	750.0	691.6	3,281
3	68.7	63.0	120.1	750.0	688.8	3,909
4	68.1	62.4	107.0	750.0	685.5	4,549
5	67.9	62.6	162.3	617.4	540.5	5,000
6	68.3	63.2	240.7	240.7	178.7	5,000
7	69.3	64.1	261.5	261.5	189.8	5,000
8	71.1	64.9	292.4	292.4	205.9	5,000
9	73.7	66.1	328.4	328.4	226.1	5,000
10	76.8	67.2	406.9	406.9	269.0	5,000
11	80.2	68.9	583.6	583.6	376.4	5,000
12	83.4	70.6	695.3	0.0	0.0	4,301
13	85.8	71.5	664.3	0.0	0.0	3,633
14	87.5	72.5	698.6	0.0	0.0	2,931
15	88.1	72.7	727.3	0.0	0.0	2,202
16	87.5	71.7	794.2	0.0	0.0	1,406
17	86.0	70.6	806.4	0.0	0.0	598
18	83.8	69.7	758.7	758.7	502.2	598
19	81.2	68.5	598.2	598.2	384.5	598
20	78.6	68.7	545.2	545.2	351.9	598
21	76.4	68.8	454.4	750.0	723.1	893
22	74.3	67.6	321.1	750.0	715.8	1,322
23	72.7	66.4	220.8	750.0	708.5	1,850
24	71.5	65.3	194.9	750.0	702.0	2,403

Hour	Typical ODDB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	145.1	750.0	702.0	3,006	150.5	750.0	702.0	3,997
2	68.2	63.5	116.3	750.0	691.6	3,638	115.6	750.0	691.6	4,629
3	66.6	62.2	88.4	750.0	684.4	4,296	88.6	463.6	393.7	5,000
4	65.4	61.1	72.4	750.0	678.5	4,970	72.3	72.3	87.9	5,000
5	64.6	60.7	101.2	134.7	159.8	5,000	101.5	101.5	118.8	5,000
6	64.4	60.7	175.6	175.6	146.6	5,000	175.5	175.5	146.6	5,000
7	64.9	61.2	173.0	173.0	146.5	5,000	173.0	173.0	146.5	5,000
8	66.3	61.6	179.8	179.8	149.9	5,000	180.0	180.0	150.0	5,000
9	68.5	62.5	178.1	178.1	150.9	5,000	178.0	178.0	150.9	5,000
10	71.4	63.6	250.5	250.5	183.9	5,000	250.6	250.6	183.9	5,000
11	74.5	65.1	396.0	396.0	256.9	5,000	396.0	396.0	256.9	5,000
12	77.6	66.8	504.8	0.0	0.0	4,491	504.8	0.0	0.0	4,491
13	80.5	68.2	495.1	0.0	0.0	3,993	495.1	0.0	0.0	3,993

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	0.0	0.0	3,464	525.9	0.0	0.0	3,464
15	84.2	70.7	562.3	0.0	0.0	2,898	562.3	0.0	0.0	2,898
16	84.6	70.5	612.6	0.0	0.0	2,283	612.6	0.0	0.0	2,283
17	84.4	70.4	668.2	0.0	0.0	1,613	668.2	0.0	0.0	1,613
18	83.6	70.7	640.3	640.3	420.8	1,613	640.3	640.3	420.8	1,613
19	82.4	70.7	496.1	496.1	330.4	1,613	496.1	496.1	330.4	1,613
20	80.8	71.9	476.3	476.3	323.1	1,613	476.3	476.3	323.1	1,613
21	78.9	72.4	433.7	750.0	746.0	1,928	433.7	750.0	746.0	1,928
22	76.8	71.1	330.5	750.0	737.6	2,346	330.5	750.0	737.6	2,346
23	74.5	69.3	243.3	750.0	726.2	2,851	243.3	750.0	726.2	2,851
24	72.2	67.2	198.3	750.0	713.3	3,401	198.3	750.0	713.3	3,401

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	150.5	750.0	702.0	3,997	150.5	750.0	702.0	3,997
2	68.2	63.5	115.6	750.0	691.6	4,629	115.6	750.0	691.6	4,629
3	66.6	62.2	88.6	463.6	393.7	5,000	88.6	463.6	393.7	5,000
4	65.4	61.1	72.3	72.3	87.9	5,000	72.3	72.3	87.9	5,000
5	64.6	60.7	101.5	101.5	118.8	5,000	101.5	101.5	118.8	5,000
6	64.4	60.7	175.5	175.5	146.6	5,000	175.5	175.5	146.6	5,000
7	64.9	61.2	173.0	173.0	146.5	5,000	173.0	173.0	146.5	5,000
8	66.3	61.6	180.0	180.0	150.0	5,000	180.0	180.0	150.0	5,000
9	68.5	62.5	178.0	178.0	150.9	5,000	178.0	178.0	150.9	5,000
10	71.4	63.6	250.6	250.6	183.9	5,000	250.6	250.6	183.9	5,000
11	74.5	65.1	396.0	396.0	256.9	5,000	396.0	396.0	256.9	5,000
12	77.6	66.8	504.8	0.0	0.0	4,491	504.8	0.0	0.0	4,491
13	80.5	68.2	495.1	0.0	0.0	3,993	495.1	0.0	0.0	3,993
14	82.7	69.7	525.9	0.0	0.0	3,464	525.9	0.0	0.0	3,464
15	84.2	70.7	562.3	0.0	0.0	2,898	562.3	0.0	0.0	2,898
16	84.6	70.5	612.6	0.0	0.0	2,283	612.6	0.0	0.0	2,283
17	84.4	70.4	668.2	0.0	0.0	1,613	668.2	0.0	0.0	1,613
18	83.6	70.7	640.3	640.3	420.8	1,613	640.3	640.3	420.8	1,613
19	82.4	70.7	496.1	496.1	330.4	1,613	496.1	496.1	330.4	1,613
20	80.8	71.9	476.3	476.3	323.1	1,613	476.3	476.3	323.1	1,613
21	78.9	72.4	433.7	750.0	746.0	1,928	433.7	750.0	746.0	1,928
22	76.8	71.1	330.5	750.0	737.6	2,346	330.5	750.0	737.6	2,346
23	74.5	69.3	243.3	750.0	726.2	2,851	243.3	750.0	726.2	2,851
24	72.2	67.2	198.3	750.0	713.3	3,401	198.3	750.0	713.3	3,401

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	76.6	750.0	676.3	4,071
2	63.3	59.8	60.2	750.0	671.7	4,758
3	62.4	59.2	48.1	294.0	256.1	5,000
4	61.8	58.5	35.4	35.4	42.0	5,000
5	61.6	58.3	42.2	42.2	50.2	5,000
6	62.0	58.7	54.3	54.3	64.5	5,000
7	63.1	59.8	142.1	142.1	132.4	5,000
8	64.9	61.3	146.5	146.5	136.4	5,000
9	67.5	62.3	207.6	207.6	162.7	5,000
10	70.6	63.4	305.6	305.6	208.3	5,000
11	74.0	65.1	491.7	491.7	308.0	5,000
12	77.3	66.6	611.3	0.0	0.0	4,385
13	79.7	68.1	579.7	0.0	0.0	3,801
14	81.3	68.9	596.3	0.0	0.0	3,202
15	81.9	69.3	623.8	0.0	0.0	2,576
16	81.3	68.8	684.1	0.0	0.0	1,890
17	79.9	68.2	694.6	0.0	0.0	1,194
18	77.7	67.0	653.5	653.5	415.7	1,194
19	75.0	66.9	506.2	506.2	322.3	1,194
20	72.4	66.6	369.5	369.5	247.9	1,194
21	70.2	65.3	283.2	750.0	702.0	1,659
22	68.1	63.7	169.8	750.0	692.8	2,238
23	66.5	62.5	112.6	750.0	686.1	2,874
24	65.3	61.6	96.5	750.0	681.1	3,525

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	68.5	750.0	680.6	4,204	74.8	628.5	546.7	5,000
2	62.0	59.7	47.6	750.0	671.1	4,903	48.1	48.1	57.6	5,000
3	60.4	58.4	26.6	127.8	154.4	5,000	26.6	26.6	31.6	5,000
4	59.2	57.1	15.4	0.0	0.0	5,000	15.4	0.0	0.0	5,000
5	58.4	56.3	19.2	0.0	0.0	5,000	19.2	0.0	0.0	5,000
6	58.2	56.1	24.3	24.3	28.9	5,000	24.3	24.3	28.9	5,000
7	58.7	56.7	8.4	0.0	0.0	5,000	8.4	0.0	0.0	5,000
8	60.1	57.9	87.6	87.6	104.0	5,000	87.6	87.6	104.0	5,000
9	62.4	58.6	79.2	79.2	94.1	5,000	79.2	79.2	94.1	5,000
10	65.2	59.6	142.2	142.2	132.4	5,000	142.9	142.9	132.7	5,000
11	68.3	61.1	275.3	275.3	189.1	5,000	275.3	275.3	189.1	5,000
12	71.5	62.7	415.0	0.0	0.0	4,581	415.0	0.0	0.0	4,581
13	74.3	64.6	413.9	0.0	0.0	4,163	414.3	0.0	0.0	4,163

COLD THERMAL STORAGE - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	0.0	0.0	3,703	456.6	0.0	0.0	3,703
15	78.0	67.1	465.5	0.0	0.0	3,235	465.5	0.0	0.0	3,235
16	78.5	67.5	514.5	0.0	0.0	2,718	514.5	0.0	0.0	2,718
17	78.2	67.9	550.9	0.0	0.0	2,165	550.9	0.0	0.0	2,165
18	77.5	68.0	499.0	499.0	322.2	2,165	499.0	499.0	322.2	2,165
19	76.3	69.3	379.7	379.7	261.0	2,165	379.7	379.7	261.0	2,165
20	74.7	70.0	348.0	348.0	246.4	2,165	348.0	348.0	246.4	2,165
21	72.7	69.0	290.0	750.0	724.4	2,623	290.0	750.0	724.4	2,623
22	70.6	67.3	190.0	750.0	713.9	3,181	190.0	750.0	713.9	3,181
23	68.3	65.4	121.4	750.0	702.6	3,807	121.4	750.0	702.6	3,807
24	66.1	63.6	104.2	750.0	692.2	4,450	104.2	750.0	692.2	4,450

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	74.8	628.8	547.1	5,000	74.8	628.8	547.1	5,000
2	62.0	59.7	48.1	48.1	57.6	5,000	48.1	48.1	57.6	5,000
3	60.4	58.4	26.6	26.6	31.6	5,000	26.6	26.6	31.6	5,000
4	59.2	57.1	15.4	0.0	0.0	5,000	15.4	0.0	0.0	5,000
5	58.4	56.3	19.2	0.0	0.0	5,000	19.2	0.0	0.0	5,000
6	58.2	56.1	24.3	24.3	28.9	5,000	24.3	24.3	28.9	5,000
7	58.7	56.7	8.4	0.0	0.0	5,000	8.4	0.0	0.0	5,000
8	60.1	57.9	87.6	87.6	104.0	5,000	87.6	87.6	104.0	5,000
9	62.4	58.6	79.2	79.2	94.1	5,000	79.2	79.2	94.1	5,000
10	65.2	59.6	142.9	142.9	132.7	5,000	142.9	142.9	132.7	5,000
11	68.3	61.1	275.3	275.3	189.1	5,000	275.3	275.3	189.1	5,000
12	71.5	62.7	415.0	0.0	0.0	4,581	415.0	0.0	0.0	4,581
13	74.3	64.6	414.3	0.0	0.0	4,163	414.3	0.0	0.0	4,163
14	76.6	66.0	456.6	0.0	0.0	3,703	456.6	0.0	0.0	3,703
15	78.0	67.1	465.5	0.0	0.0	3,235	465.5	0.0	0.0	3,235
16	78.5	67.5	514.5	0.0	0.0	2,718	514.5	0.0	0.0	2,718
17	78.2	67.9	550.9	0.0	0.0	2,165	550.9	0.0	0.0	2,165
18	77.5	68.0	499.0	499.0	322.2	2,165	499.0	499.0	322.2	2,165
19	76.3	69.3	379.7	379.7	261.0	2,165	379.7	379.7	261.0	2,165
20	74.7	70.0	348.0	348.0	246.4	2,165	348.0	348.0	246.4	2,165
21	72.7	69.0	290.0	750.0	724.4	2,623	290.0	750.0	724.4	2,623
22	70.6	67.3	190.0	750.0	713.9	3,181	190.0	750.0	713.9	3,181
23	68.3	65.4	121.4	750.0	702.6	3,807	121.4	750.0	702.6	3,807
24	66.1	63.6	104.2	750.0	692.2	4,450	104.2	750.0	692.2	4,450

ECO IH-5

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

June

Hour	Design ODDB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	2,600
2	67.8	64.4	0.0	0.0	0.0	2,600
3	67.0	63.5	0.0	0.0	0.0	2,600
4	66.4	62.7	0.0	0.0	0.0	2,600
5	66.3	62.7	0.0	0.0	0.0	2,600
6	66.6	63.7	0.0	0.0	0.0	2,600
7	67.6	64.5	0.0	0.0	0.0	2,600
8	69.3	65.1	0.0	0.0	0.0	2,600
9	71.8	66.0	65.3	65.3	84.1	2,600
10	74.6	67.6	109.2	109.2	117.8	2,600
11	77.8	69.8	241.8	241.8	181.1	2,600
12	80.9	71.9	384.5	384.5	262.4	2,600
13	83.2	73.5	353.7	0.0	0.0	2,244
14	84.7	74.4	435.0	0.0	0.0	1,807
15	85.3	74.6	542.1	0.0	0.0	1,264
16	84.7	74.5	682.4	682.4	475.9	1,264
17	83.4	73.5	806.8	806.8	577.8	1,264
18	81.3	71.5	768.0	768.0	534.5	1,264
19	78.8	70.1	652.3	652.3	434.7	1,264
20	76.3	70.0	591.1	591.1	388.7	1,264
21	74.2	69.5	546.4	546.4	355.5	1,264
22	72.3	68.7	422.4	422.4	274.8	1,264
23	70.8	67.1	246.2	246.2	177.8	1,264
24	69.7	65.8	170.5	170.5	140.9	1,264

Hour	Typical ODDB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	119.5	630.0	589.6	1,773	125.9	630.0	589.6	1,468
2	66.0	63.9	103.2	630.0	582.8	2,299	102.7	630.0	582.8	1,994
3	64.6	62.4	79.4	382.5	325.4	2,600	79.5	630.0	575.8	2,543
4	63.7	61.3	65.3	65.3	79.4	2,600	65.3	124.7	141.7	2,600
5	63.0	60.8	69.4	69.4	83.8	2,600	69.4	69.4	83.8	2,600
6	62.8	61.2	153.4	153.4	126.4	2,600	153.5	153.5	126.4	2,600
7	63.4	61.7	195.5	195.5	144.6	2,600	195.5	195.5	144.6	2,600
8	65.1	62.3	185.3	185.3	141.3	2,600	185.6	185.6	141.5	2,600
9	67.6	63.3	220.8	220.8	158.6	2,600	220.8	220.8	158.6	2,600
10	70.7	65.2	286.9	286.9	193.3	2,600	286.9	286.9	193.3	2,600
11	74.0	67.5	432.3	432.3	276.7	2,600	432.3	432.3	276.7	2,600
12	77.1	69.8	557.6	557.6	364.2	2,600	557.6	557.6	364.2	2,600
13	79.6	71.6	535.2	0.0	0.0	2,063	535.2	0.0	0.0	2,063

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	0.0	0.0	1,527	534.2	0.0	0.0	1,527
15	81.8	72.8	561.4	0.0	0.0	964	561.4	0.0	0.0	964
16	81.6	73.1	609.6	609.6	413.5	964	609.6	609.6	413.5	964
17	81.0	72.7	678.8	678.8	465.6	964	678.8	678.8	465.6	964
18	80.0	71.6	665.1	665.1	450.4	964	665.1	665.1	450.4	964
19	78.7	71.3	542.0	542.0	358.3	964	542.0	542.0	358.3	964
20	77.1	72.0	496.4	496.4	330.7	964	496.4	496.4	330.7	964
21	75.3	71.8	448.1	448.1	299.8	964	448.1	448.1	299.8	964
22	73.3	71.0	338.5	338.5	234.0	964	338.5	338.5	234.0	964
23	71.3	68.9	227.4	227.4	172.4	964	227.4	227.4	172.4	964
24	69.4	66.8	158.1	158.1	137.1	964	158.1	158.1	137.1	964

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	125.9	630.0	589.6	1,468	125.9	630.0	589.6	1,468
2	66.0	63.9	102.7	630.0	582.8	1,994	102.7	630.0	582.8	1,994
3	64.6	62.4	79.5	630.0	575.8	2,543	79.5	630.0	575.8	2,543
4	63.7	61.3	65.3	124.7	141.7	2,600	65.3	124.7	141.7	2,600
5	63.0	60.8	69.4	69.4	83.8	2,600	69.4	69.4	83.8	2,600
6	62.8	61.2	153.5	153.5	126.4	2,600	153.5	153.5	126.4	2,600
7	63.4	61.7	195.5	195.5	144.6	2,600	195.5	195.5	144.6	2,600
8	65.1	62.3	185.6	185.6	141.5	2,600	185.6	185.6	141.5	2,600
9	67.6	63.3	220.8	220.8	158.6	2,600	220.8	220.8	158.6	2,600
10	70.7	65.2	286.9	286.9	193.3	2,600	286.9	286.9	193.3	2,600
11	74.0	67.5	432.3	432.3	276.7	2,600	432.3	432.3	276.7	2,600
12	77.1	69.8	557.6	557.6	364.2	2,600	557.6	557.6	364.2	2,600
13	79.6	71.6	535.2	0.0	0.0	2,063	535.2	0.0	0.0	2,063
14	81.3	72.7	534.2	0.0	0.0	1,527	534.2	0.0	0.0	1,527
15	81.8	72.8	561.4	0.0	0.0	964	561.4	0.0	0.0	964
16	81.6	73.1	609.6	609.6	413.5	964	609.6	609.6	413.5	964
17	81.0	72.7	678.8	678.8	465.6	964	678.8	678.8	465.6	964
18	80.0	71.6	665.1	665.1	450.4	964	665.1	665.1	450.4	964
19	78.7	71.3	542.0	542.0	358.3	964	542.0	542.0	358.3	964
20	77.1	72.0	496.4	496.4	330.7	964	496.4	496.4	330.7	964
21	75.3	71.8	448.1	448.1	299.8	964	448.1	448.1	299.8	964
22	73.3	71.0	338.5	338.5	234.0	964	338.5	338.5	234.0	964
23	71.3	68.9	227.4	227.4	172.4	964	227.4	227.4	172.4	964
24	69.4	66.8	158.1	158.1	137.1	964	158.1	158.1	137.1	964

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	258.3	630.0	607.4	1,335
2	72.3	67.9	206.7	630.0	602.7	1,757
3	71.4	67.2	185.6	630.0	599.1	2,200
4	70.7	67.0	180.9	582.3	542.2	2,600
5	70.5	66.9	252.9	252.9	180.5	2,600
6	71.0	67.4	326.9	326.9	218.7	2,600
7	72.1	68.4	380.7	380.7	250.3	2,600
8	74.1	69.3	401.4	401.4	264.5	2,600
9	77.0	70.1	420.6	420.6	278.0	2,600
10	80.4	71.4	494.4	494.4	327.3	2,600
11	84.2	73.3	672.3	672.3	462.9	2,600
12	87.8	75.5	775.6	775.6	559.6	2,600
13	90.5	76.5	733.0	0.0	0.0	1,865
14	92.3	76.8	763.3	0.0	0.0	1,100
15	93.0	77.0	805.4	0.0	0.0	294
16	92.3	76.7	891.8	820.0	605.7	222
17	90.8	75.3	889.6	820.0	598.6	153
18	88.3	74.2	860.2	820.0	593.1	112
19	85.4	72.9	714.1	714.1	495.2	112
20	82.4	73.4	680.5	680.5	469.9	112
21	80.0	73.0	641.2	641.2	437.2	112
22	77.7	72.3	559.5	559.5	374.0	112
23	75.9	70.6	426.3	426.3	282.9	112
24	74.6	69.4	280.2	280.2	199.4	112

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	259.7	630.0	619.0	482	265.3	630.0	619.0	1,144
2	71.9	68.8	219.9	630.0	607.4	892	214.6	630.0	607.4	1,558
3	69.9	67.0	167.1	630.0	598.1	1,354	167.3	630.0	598.1	2,020
4	68.3	65.9	152.3	630.0	592.6	1,831	152.7	630.0	592.6	2,496
5	67.4	65.2	203.0	630.0	589.1	2,256	203.1	309.5	275.6	2,600
6	67.0	64.9	256.9	602.2	555.1	2,600	256.9	256.9	178.3	2,600
7	67.5	65.3	274.1	274.1	187.3	2,600	274.2	274.2	187.4	2,600
8	68.8	65.6	262.6	262.6	182.5	2,600	262.6	262.6	182.5	2,600
9	70.9	65.7	248.7	248.7	176.1	2,600	248.7	248.7	176.1	2,600
10	73.6	66.5	305.3	305.3	205.5	2,600	305.3	305.3	205.5	2,600
11	76.7	67.9	454.0	454.0	290.6	2,600	454.0	454.0	290.6	2,600
12	79.9	69.9	581.5	581.5	381.5	2,600	581.5	581.5	381.5	2,600
13	83.0	71.3	563.2	0.0	0.0	2,035	563.2	0.0	0.0	2,035

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

			Weekday				Saturday			
Hour	Typical OADB (F)	Typical OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	0.0	0.0	1,435	597.7	0.0	0.0	1,435
15	87.8	73.9	654.3	0.0	0.0	780	654.3	0.0	0.0	780
16	89.1	75.3	737.3	737.3	525.3	780	737.3	737.3	525.3	780
17	89.5	75.5	810.6	810.6	591.1	780	810.6	810.6	591.1	780
18	89.2	76.2	803.8	803.8	588.3	780	803.8	803.8	588.3	780
19	88.3	76.7	700.3	700.3	500.1	780	700.3	700.3	500.1	780
20	86.7	78.6	684.0	684.0	494.6	780	684.0	684.0	494.6	780
21	84.7	78.8	656.5	656.5	472.6	780	656.5	656.5	472.6	780
22	82.3	78.0	549.7	549.7	389.2	780	549.7	549.7	389.2	780
23	79.6	75.4	419.7	419.7	293.8	780	419.7	419.7	293.8	780
24	76.9	73.0	325.9	325.9	232.2	780	325.9	325.9	232.2	780

			Sunday				Monday			
Hour	Typical OADB (F)	Typical OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	265.3	630.0	619.0	1,144	265.3	630.0	619.0	1,144
2	71.9	68.8	214.6	630.0	607.4	1,558	214.6	630.0	607.4	1,558
3	69.9	67.0	167.3	630.0	598.1	2,020	167.3	630.0	598.1	2,020
4	68.3	65.9	152.7	630.0	592.6	2,496	152.7	630.0	592.6	2,496
5	67.4	65.2	203.1	309.5	275.6	2,600	203.1	309.5	275.6	2,600
6	67.0	64.9	256.9	256.9	178.3	2,600	256.9	256.9	178.3	2,600
7	67.5	65.3	274.2	274.2	187.4	2,600	274.2	274.2	187.4	2,600
8	68.8	65.6	262.6	262.6	182.5	2,600	262.6	262.6	182.5	2,600
9	70.9	65.7	248.7	248.7	176.1	2,600	248.7	248.7	176.1	2,600
10	73.6	66.5	305.3	305.3	205.5	2,600	305.3	305.3	205.5	2,600
11	76.7	67.9	454.0	454.0	290.6	2,600	454.0	454.0	290.6	2,600
12	79.9	69.9	581.5	581.5	381.5	2,600	581.5	581.5	381.5	2,600
13	83.0	71.3	563.2	0.0	0.0	2,035	563.2	0.0	0.0	2,035
14	85.7	72.5	597.7	0.0	0.0	1,435	597.7	0.0	0.0	1,435
15	87.8	73.9	654.3	0.0	0.0	780	654.3	0.0	0.0	780
16	89.1	75.3	737.3	737.3	525.3	780	737.3	737.3	525.3	780
17	89.5	75.5	810.6	810.6	591.1	780	810.6	810.6	591.1	780
18	89.2	76.2	803.8	803.8	588.3	780	803.8	803.8	588.3	780
19	88.3	76.7	700.3	700.3	500.1	780	700.3	700.3	500.1	780
20	86.7	78.6	684.0	684.0	494.6	780	684.0	684.0	494.6	780
21	84.7	78.8	656.5	656.5	472.6	780	656.5	656.5	472.6	780
22	82.3	78.0	549.7	549.7	389.2	780	549.7	549.7	389.2	780
23	79.6	75.4	419.7	419.7	293.8	780	419.7	419.7	293.8	780
24	76.9	73.0	325.9	325.9	232.2	780	325.9	325.9	232.2	780

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

August

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	164.0	630.0	585.7	1,245
2	69.5	63.5	133.5	630.0	580.9	1,741
3	68.7	63.0	120.1	630.0	578.6	2,249
4	68.1	62.4	107.0	459.4	394.7	2,600
5	67.9	62.6	162.3	162.3	132.2	2,600
6	68.3	63.2	240.7	240.7	167.3	2,600
7	69.3	64.1	261.5	261.5	178.7	2,600
8	71.1	64.9	292.4	292.4	195.3	2,600
9	73.7	66.1	328.4	328.4	216.3	2,600
10	76.8	67.2	406.9	406.9	261.4	2,600
11	80.2	68.9	583.6	583.6	379.5	2,600
12	83.4	70.6	695.3	695.3	470.4	2,600
13	85.8	71.5	664.3	0.0	0.0	1,934
14	87.5	72.5	698.6	0.0	0.0	1,233
15	88.1	72.7	727.3	0.0	0.0	505
16	87.5	71.7	794.2	794.2	558.1	505
17	86.0	70.6	806.4	806.4	563.7	505
18	83.8	69.7	758.7	758.7	518.7	505
19	81.2	68.5	598.2	598.2	388.6	505
20	78.6	68.7	545.2	545.2	352.1	505
21	76.4	68.8	454.4	454.4	293.8	505
22	74.3	67.6	321.1	321.1	216.2	505
23	72.7	66.4	220.8	220.8	164.5	505
24	71.5	65.3	194.9	194.9	150.7	505

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	145.1	630.0	589.6	990	150.5	630.0	589.6	1,490
2	68.2	63.5	116.3	630.0	580.9	1,503	115.6	630.0	580.9	2,004
3	66.6	62.2	88.4	630.0	574.8	2,043	88.6	630.0	574.8	2,543
4	65.4	61.1	72.4	630.0	569.8	2,599	72.3	130.9	144.9	2,600
5	64.6	60.7	101.2	104.4	129.4	2,600	101.5	101.5	105.8	2,600
6	64.4	60.7	175.6	175.6	134.6	2,600	175.5	175.5	134.6	2,600
7	64.9	61.2	173.0	173.0	134.3	2,600	173.0	173.0	134.4	2,600
8	66.3	61.6	179.8	179.8	137.8	2,600	180.0	180.0	137.9	2,600
9	68.5	62.5	178.1	178.1	138.6	2,600	178.0	178.0	138.6	2,600
10	71.4	63.6	250.5	250.5	172.6	2,600	250.6	250.6	172.6	2,600
11	74.5	65.1	396.0	396.0	249.1	2,600	396.0	396.0	249.1	2,600
12	77.6	66.8	504.8	504.8	319.3	2,600	504.8	504.8	319.3	2,600
13	80.5	68.2	495.1	0.0	0.0	2,103	495.1	0.0	0.0	2,103

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	0.0	0.0	1,575	525.9	0.0	0.0	1,575
15	84.2	70.7	562.3	0.0	0.0	1,012	562.3	0.0	0.0	1,012
16	84.6	70.5	612.6	612.6	406.2	1,012	612.6	612.6	406.2	1,012
17	84.4	70.4	668.2	668.2	448.1	1,012	668.2	668.2	448.1	1,012
18	83.6	70.7	640.3	640.3	427.8	1,012	640.3	640.3	427.8	1,012
19	82.4	70.7	496.1	496.1	325.8	1,012	496.1	496.1	325.8	1,012
20	80.8	71.9	476.3	476.3	317.6	1,012	476.3	476.3	317.6	1,012
21	78.9	72.4	433.7	433.7	293.1	1,012	433.7	433.7	293.1	1,012
22	76.8	71.1	330.5	330.5	229.9	1,012	330.5	330.5	229.9	1,012
23	74.5	69.3	243.3	243.3	180.8	1,012	243.3	243.3	180.8	1,012
24	72.2	67.2	198.3	198.3	155.6	1,012	198.3	198.3	155.6	1,012

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	70.1	65.3	150.5	630.0	589.6	1,490	150.5	630.0	589.6	1,490
2	68.2	63.5	115.6	630.0	580.9	2,004	115.6	630.0	580.9	2,004
3	66.6	62.2	88.6	630.0	574.8	2,543	88.6	630.0	574.8	2,543
4	65.4	61.1	72.3	130.9	144.9	2,600	72.3	130.9	144.9	2,600
5	64.6	60.7	101.5	101.5	105.8	2,600	101.5	101.5	105.8	2,600
6	64.4	60.7	175.5	175.5	134.6	2,600	175.5	175.5	134.6	2,600
7	64.9	61.2	173.0	173.0	134.4	2,600	173.0	173.0	134.4	2,600
8	66.3	61.6	180.0	180.0	137.9	2,600	180.0	180.0	137.9	2,600
9	68.5	62.5	178.0	178.0	138.6	2,600	178.0	178.0	138.6	2,600
10	71.4	63.6	250.6	250.6	172.6	2,600	250.6	250.6	172.6	2,600
11	74.5	65.1	396.0	396.0	249.1	2,600	396.0	396.0	249.1	2,600
12	77.6	66.8	504.8	504.8	319.3	2,600	504.8	504.8	319.3	2,600
13	80.5	68.2	495.1	0.0	0.0	2,103	495.1	0.0	0.0	2,103
14	82.7	69.7	525.9	0.0	0.0	1,575	525.9	0.0	0.0	1,575
15	84.2	70.7	562.3	0.0	0.0	1,012	562.3	0.0	0.0	1,012
16	84.6	70.5	612.6	612.6	406.2	1,012	612.6	612.6	406.2	1,012
17	84.4	70.4	668.2	668.2	448.1	1,012	668.2	668.2	448.1	1,012
18	83.6	70.7	640.3	640.3	427.8	1,012	640.3	640.3	427.8	1,012
19	82.4	70.7	496.1	496.1	325.8	1,012	496.1	496.1	325.8	1,012
20	80.8	71.9	476.3	476.3	317.6	1,012	476.3	476.3	317.6	1,012
21	78.9	72.4	433.7	433.7	293.1	1,012	433.7	433.7	293.1	1,012
22	76.8	71.1	330.5	330.5	229.9	1,012	330.5	330.5	229.9	1,012
23	74.5	69.3	243.3	243.3	180.8	1,012	243.3	243.3	180.8	1,012
24	72.2	67.2	198.3	198.3	155.6	1,012	198.3	198.3	155.6	1,012

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	76.6	630.0	568.1	1,564
2	63.3	59.8	60.2	630.0	564.1	2,133
3	62.4	59.2	48.1	517.0	439.2	2,600
4	61.8	58.5	35.4	35.4	42.0	2,600
5	61.6	58.3	42.2	42.2	50.2	2,600
6	62.0	58.7	54.3	54.3	64.5	2,600
7	63.1	59.8	142.1	142.1	120.1	2,600
8	64.9	61.3	146.5	146.5	123.8	2,600
9	67.5	62.3	207.6	207.6	150.9	2,600
10	70.6	63.4	305.6	305.6	198.3	2,600
11	74.0	65.1	491.7	491.7	306.0	2,600
12	77.3	66.6	611.3	611.3	391.5	2,600
13	79.7	68.1	579.7	0.0	0.0	2,018
14	81.3	68.9	596.3	0.0	0.0	1,420
15	81.9	69.3	623.8	0.0	0.0	795
16	81.3	68.8	684.1	684.1	454.4	795
17	79.9	68.2	694.6	694.6	460.3	795
18	77.7	67.0	653.5	653.5	424.1	795
19	75.0	66.9	506.2	506.2	320.5	795
20	72.4	66.6	369.5	369.5	239.2	795
21	70.2	65.3	283.2	283.2	191.8	795
22	68.1	63.7	169.8	169.8	137.1	795
23	66.5	62.5	112.6	112.6	112.3	795
24	65.3	61.6	96.5	96.5	105.1	795

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	68.5	630.0	571.6	1,356	74.8	630.0	571.6	1,813
2	62.0	59.7	47.6	630.0	563.7	1,938	48.1	630.0	563.7	2,393
3	60.4	58.4	26.6	630.0	558.2	2,539	26.6	235.1	207.3	2,600
4	59.2	57.1	15.4	78.0	113.8	2,600	15.4	0.0	0.0	2,600
5	58.4	56.3	19.2	19.2	22.8	2,600	19.2	19.2	22.8	2,600
6	58.2	56.1	24.3	24.3	28.9	2,600	24.3	24.3	28.9	2,600
7	58.7	56.7	8.4	0.0	0.0	2,600	8.4	0.0	0.0	2,600
8	60.1	57.9	87.6	87.6	99.4	2,600	87.6	87.6	99.4	2,600
9	62.4	58.6	79.2	79.2	94.1	2,600	79.2	79.2	94.1	2,600
10	65.2	59.6	142.2	142.2	120.1	2,600	142.9	142.9	120.4	2,600
11	68.3	61.1	275.3	275.3	178.7	2,600	275.3	275.3	178.7	2,600
12	71.5	62.7	415.0	415.0	253.8	2,600	415.0	415.0	253.8	2,600
13	74.3	64.6	413.9	0.0	0.0	2,184	414.3	0.0	0.0	2,184

COLD THERMAL STORAGE - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	0.0	0.0	1,726	456.6	0.0	0.0	1,725
15	78.0	67.1	465.5	0.0	0.0	1,259	465.5	0.0	0.0	1,258
16	78.5	67.5	514.5	514.5	327.8	1,259	514.5	514.5	327.8	1,258
17	78.2	67.9	550.9	550.9	353.4	1,259	550.9	550.9	353.4	1,258
18	77.5	68.0	499.0	499.0	319.2	1,259	499.0	499.0	319.2	1,258
19	76.3	69.3	379.7	379.7	252.3	1,259	379.7	379.7	252.3	1,258
20	74.7	70.0	348.0	348.0	236.7	1,259	348.0	348.0	236.7	1,258
21	72.7	69.0	290.0	290.0	203.5	1,259	290.0	290.0	203.5	1,258
22	70.6	67.3	190.0	190.0	152.0	1,259	190.0	190.0	152.0	1,258
23	68.3	65.4	121.4	121.4	119.6	1,259	121.4	121.4	119.6	1,258
24	66.1	63.6	104.2	104.2	110.6	1,259	104.2	104.2	110.6	1,258

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	74.8	630.0	571.6	1,813	74.8	630.0	571.6	1,813
2	62.0	59.7	48.1	630.0	563.7	2,393	48.1	630.0	563.7	2,393
3	60.4	58.4	26.6	235.4	207.5	2,600	26.6	235.4	207.5	2,600
4	59.2	57.1	15.4	0.0	0.0	2,600	15.4	0.0	0.0	2,600
5	58.4	56.3	19.2	19.2	22.8	2,600	19.2	19.2	22.8	2,600
6	58.2	56.1	24.3	24.3	28.9	2,600	24.3	24.3	28.9	2,600
7	58.7	56.7	8.4	0.0	0.0	2,600	8.4	0.0	0.0	2,600
8	60.1	57.9	87.6	87.6	99.4	2,600	87.6	87.6	99.4	2,600
9	62.4	58.6	79.2	79.2	94.1	2,600	79.2	79.2	94.1	2,600
10	65.2	59.6	142.9	142.9	120.4	2,600	142.9	142.9	120.4	2,600
11	68.3	61.1	275.3	275.3	178.7	2,600	275.3	275.3	178.7	2,600
12	71.5	62.7	415.0	415.0	253.8	2,600	415.0	415.0	253.8	2,600
13	74.3	64.6	414.3	0.0	0.0	2,184	414.3	0.0	0.0	2,184
14	76.6	66.0	456.6	0.0	0.0	1,725	456.6	0.0	0.0	1,725
15	78.0	67.1	465.5	0.0	0.0	1,258	465.5	0.0	0.0	1,258
16	78.5	67.5	514.5	514.5	327.8	1,258	514.5	514.5	327.8	1,258
17	78.2	67.9	550.9	550.9	353.4	1,258	550.9	550.9	353.4	1,258
18	77.5	68.0	499.0	499.0	319.2	1,258	499.0	499.0	319.2	1,258
19	76.3	69.3	379.7	379.7	252.3	1,258	379.7	379.7	252.3	1,258
20	74.7	70.0	348.0	348.0	236.7	1,258	348.0	348.0	236.7	1,258
21	72.7	69.0	290.0	290.0	203.5	1,258	290.0	290.0	203.5	1,258
22	70.6	67.3	190.0	190.0	152.0	1,258	190.0	190.0	152.0	1,258
23	68.3	65.4	121.4	121.4	119.6	1,258	121.4	121.4	119.6	1,258
24	66.1	63.6	104.2	104.2	110.6	1,258	104.2	104.2	110.6	1,258

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COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	3,300
2	67.8	64.4	0.0	0.0	0.0	3,300
3	67.0	63.5	0.0	0.0	0.0	3,300
4	66.4	62.7	0.0	0.0	0.0	3,300
5	66.3	62.7	0.0	0.0	0.0	3,300
6	66.6	63.7	0.0	0.0	0.0	3,300
7	67.6	64.5	0.0	0.0	0.0	3,300
8	69.3	65.1	0.0	0.0	0.0	3,300
9	71.8	66.0	65.3	65.3	74.9	3,300
10	74.6	67.6	109.2	109.2	96.3	3,300
11	77.8	69.8	241.8	241.8	171.7	3,300
12	80.9	71.9	384.5	384.5	277.1	3,300
13	83.2	73.5	353.7	353.7	256.3	3,300
14	84.7	74.4	435.0	435.0	326.8	3,300
15	85.3	74.6	542.1	500.0	388.1	3,258
16	84.7	74.5	682.4	500.0	387.8	3,076
17	83.4	73.5	806.8	500.0	384.5	2,769
18	81.3	71.5	768.0	500.0	378.2	2,501
19	78.8	70.1	652.3	500.0	373.9	2,348
20	76.3	70.0	591.1	500.0	373.6	2,257
21	74.2	69.5	546.4	500.0	372.1	2,211
22	72.3	68.7	422.4	422.4	300.5	2,211
23	70.8	67.1	246.2	246.2	169.1	2,211
24	69.7	65.8	170.5	170.5	124.6	2,211

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	375.0	349.8	2,584	0.0	375.0	349.8	2,989
2	66.0	63.9	0.0	375.0	345.7	2,957	0.0	313.3	277.5	3,300
3	64.6	62.4	0.0	345.3	307.8	3,300	0.0	0.0	0.0	3,300
4	63.7	61.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
5	63.0	60.8	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
6	62.8	61.2	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	63.4	61.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	65.1	62.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	67.6	63.3	220.8	220.8	147.6	3,300	220.8	220.8	147.6	3,300
10	70.7	65.2	286.9	286.9	191.1	3,300	286.9	286.9	191.2	3,300
11	74.0	67.5	432.3	432.3	305.8	3,300	432.3	432.3	305.8	3,300
12	77.1	69.8	557.6	500.0	373.0	3,242	557.6	500.0	373.0	3,242
13	79.6	71.6	535.2	500.0	378.5	3,207	535.2	500.0	378.5	3,207

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	500.0	382.0	3,173	534.2	500.0	382.0	3,173
15	81.8	72.8	561.4	500.0	382.3	3,112	561.4	500.0	382.3	3,112
16	81.6	73.1	609.6	500.0	383.3	3,002	609.6	500.0	383.3	3,002
17	81.0	72.7	678.8	500.0	382.0	2,823	678.8	500.0	382.0	2,823
18	80.0	71.6	665.1	500.0	378.5	2,658	665.1	500.0	378.5	2,658
19	78.7	71.3	542.0	500.0	377.6	2,616	542.0	500.0	377.6	2,616
20	77.1	72.0	496.4	496.4	376.3	2,616	496.4	496.4	376.3	2,616
21	75.3	71.8	448.1	448.1	331.1	2,616	448.1	448.1	331.1	2,616
22	73.3	71.0	338.5	338.5	239.0	2,616	338.5	338.5	239.0	2,616
23	71.3	68.9	227.4	227.4	161.4	2,616	227.4	227.4	161.4	2,616
24	69.4	66.8	158.1	158.1	119.6	2,616	158.1	158.1	119.6	2,616

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	375.0	349.8	2,989	0.0	375.0	349.8	2,989
2	66.0	63.9	0.0	313.3	277.5	3,300	0.0	313.3	277.5	3,300
3	64.6	62.4	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
4	63.7	61.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
5	63.0	60.8	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
6	62.8	61.2	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	63.4	61.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	65.1	62.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	67.6	63.3	220.8	220.8	147.6	3,300	220.8	220.8	147.6	3,300
10	70.7	65.2	286.9	286.9	191.2	3,300	286.9	286.9	191.2	3,300
11	74.0	67.5	432.3	432.3	305.8	3,300	432.3	432.3	305.8	3,300
12	77.1	69.8	557.6	500.0	373.0	3,242	557.6	500.0	373.0	3,242
13	79.6	71.6	535.2	500.0	378.5	3,207	535.2	500.0	378.5	3,207
14	81.3	72.7	534.2	500.0	382.0	3,173	534.2	500.0	382.0	3,173
15	81.8	72.8	561.4	500.0	382.3	3,112	561.4	500.0	382.3	3,112
16	81.6	73.1	609.6	500.0	383.3	3,002	609.6	500.0	383.3	3,002
17	81.0	72.7	678.8	500.0	382.0	2,823	678.8	500.0	382.0	2,823
18	80.0	71.6	665.1	500.0	378.5	2,658	665.1	500.0	378.5	2,658
19	78.7	71.3	542.0	500.0	377.6	2,616	542.0	500.0	377.6	2,616
20	77.1	72.0	496.4	496.4	376.3	2,616	496.4	496.4	376.3	2,616
21	75.3	71.8	448.1	448.1	331.1	2,616	448.1	448.1	331.1	2,616
22	73.3	71.0	338.5	338.5	239.0	2,616	338.5	338.5	239.0	2,616
23	71.3	68.9	227.4	227.4	161.4	2,616	227.4	227.4	161.4	2,616
24	69.4	66.8	158.1	158.1	119.6	2,616	158.1	158.1	119.6	2,616

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	0.0	375.0	360.5	2,989
2	72.3	67.9	0.0	313.3	287.8	3,300
3	71.4	67.2	0.0	0.0	0.0	3,300
4	70.7	67.0	0.0	0.0	0.0	3,300
5	70.5	66.9	0.0	0.0	0.0	3,300
6	71.0	67.4	0.0	0.0	0.0	3,300
7	72.1	68.4	0.0	0.0	0.0	3,300
8	74.1	69.3	1.4	0.0	0.0	3,300
9	77.0	70.1	420.6	420.6	302.6	3,300
10	80.4	71.4	494.4	494.4	372.6	3,300
11	84.2	73.3	672.3	500.0	383.9	3,128
12	87.8	75.5	775.6	500.0	391.0	2,852
13	90.5	76.5	733.0	500.0	394.4	2,619
14	92.3	76.8	763.3	500.0	395.4	2,356
15	93.0	77.0	805.4	500.0	396.0	2,050
16	92.3	76.7	891.8	500.0	395.0	1,659
17	90.8	75.3	889.6	500.0	390.4	1,269
18	88.3	74.2	860.2	500.0	386.8	909
19	85.4	72.9	714.1	500.0	382.6	695
20	82.4	73.4	680.5	500.0	384.2	514
21	80.0	73.0	641.2	500.0	382.9	373
22	77.7	72.3	559.5	500.0	380.7	314
23	75.9	70.6	426.3	426.3	308.8	314
24	74.6	69.4	280.2	280.2	194.9	314

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	375.0	367.5	688	0.0	375.0	367.5	1,835
2	71.9	68.8	0.0	375.0	360.5	1,063	0.0	375.0	360.5	2,208
3	69.9	67.0	0.0	375.0	354.9	1,437	0.0	375.0	354.9	2,582
4	68.3	65.9	0.0	375.0	351.6	1,811	0.0	375.0	351.6	2,955
5	67.4	65.2	0.0	375.0	349.5	2,184	0.0	347.8	318.1	3,300
6	67.0	64.9	0.0	375.0	348.6	2,558	0.0	0.0	0.0	3,300
7	67.5	65.3	0.0	375.0	349.8	2,931	0.0	0.0	0.0	3,300
8	68.8	65.6	0.0	371.8	346.9	3,300	0.0	0.0	0.0	3,300
9	70.9	65.7	248.7	248.7	167.9	3,300	248.7	248.7	167.9	3,300
10	73.6	66.5	305.3	305.3	205.9	3,300	305.3	305.3	205.9	3,300
11	76.7	67.9	454.0	454.0	325.6	3,300	454.0	454.0	325.6	3,300
12	79.9	69.9	581.5	500.0	373.3	3,218	581.5	500.0	373.3	3,218
13	83.0	71.3	563.2	500.0	377.6	3,155	563.2	500.0	377.6	3,155

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	500.0	381.4	3,058	597.7	500.0	381.4	3,058
15	87.8	73.9	654.3	500.0	385.8	2,903	654.3	500.0	385.8	2,903
16	89.1	75.3	737.3	500.0	390.4	2,666	737.3	500.0	390.4	2,666
17	89.5	75.5	810.6	500.0	391.0	2,355	810.6	500.0	391.0	2,355
18	89.2	76.2	803.8	500.0	393.4	2,052	803.8	500.0	393.4	2,052
19	88.3	76.7	700.3	500.0	395.0	1,851	700.3	500.0	395.0	1,851
20	86.7	78.6	684.0	500.0	401.4	1,667	684.0	500.0	401.4	1,667
21	84.7	78.8	656.5	500.0	402.1	1,511	656.5	500.0	402.1	1,511
22	82.3	78.0	549.7	500.0	399.4	1,461	549.7	500.0	399.4	1,461
23	79.6	75.4	419.7	419.7	316.0	1,461	419.7	419.7	316.0	1,461
24	76.9	73.0	325.9	325.9	234.2	1,461	325.9	325.9	234.2	1,461

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	375.0	367.5	1,835	0.0	375.0	367.5	1,835
2	71.9	68.8	0.0	375.0	360.5	2,208	0.0	375.0	360.5	2,208
3	69.9	67.0	0.0	375.0	354.9	2,582	0.0	375.0	354.9	2,582
4	68.3	65.9	0.0	375.0	351.6	2,955	0.0	375.0	351.6	2,955
5	67.4	65.2	0.0	347.8	318.1	3,300	0.0	347.8	318.1	3,300
6	67.0	64.9	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	67.5	65.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	68.8	65.6	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	70.9	65.7	248.7	248.7	167.9	3,300	248.7	248.7	167.9	3,300
10	73.6	66.5	305.3	305.3	205.9	3,300	305.3	305.3	205.9	3,300
11	76.7	67.9	454.0	454.0	325.6	3,300	454.0	454.0	325.6	3,300
12	79.9	69.9	581.5	500.0	373.3	3,218	581.5	500.0	373.3	3,218
13	83.0	71.3	563.2	500.0	377.6	3,155	563.2	500.0	377.6	3,155
14	85.7	72.5	597.7	500.0	381.4	3,058	597.7	500.0	381.4	3,058
15	87.8	73.9	654.3	500.0	385.8	2,903	654.3	500.0	385.8	2,903
16	89.1	75.3	737.3	500.0	390.4	2,666	737.3	500.0	390.4	2,666
17	89.5	75.5	810.6	500.0	391.0	2,355	810.6	500.0	391.0	2,355
18	89.2	76.2	803.8	500.0	393.4	2,052	803.8	500.0	393.4	2,052
19	88.3	76.7	700.3	500.0	395.0	1,851	700.3	500.0	395.0	1,851
20	86.7	78.6	684.0	500.0	401.4	1,667	684.0	500.0	401.4	1,667
21	84.7	78.8	656.5	500.0	402.1	1,511	656.5	500.0	402.1	1,511
22	82.3	78.0	549.7	500.0	399.4	1,461	549.7	500.0	399.4	1,461
23	79.6	75.4	419.7	419.7	316.0	1,461	419.7	419.7	316.0	1,461
24	76.9	73.0	325.9	325.9	234.2	1,461	325.9	325.9	234.2	1,461

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

Hour	Design ODB (F)	Design OWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	0.0	375.0	347.4	1,835
2	69.5	63.5	0.0	375.0	344.6	2,208
3	68.7	63.0	0.0	375.0	343.1	2,582
4	68.1	62.4	0.0	375.0	341.4	2,955
5	67.9	62.6	0.0	347.8	311.1	3,300
6	68.3	63.2	0.0	0.0	0.0	3,300
7	69.3	64.1	0.0	0.0	0.0	3,300
8	71.1	64.9	0.0	0.0	0.0	3,300
9	73.7	66.1	328.4	328.4	221.3	3,300
10	76.8	67.2	406.9	406.9	283.9	3,300
11	80.2	68.9	583.6	500.0	370.3	3,216
12	83.4	70.6	695.3	500.0	375.4	3,021
13	85.8	71.5	664.3	500.0	378.2	2,857
14	87.5	72.5	698.6	500.0	381.4	2,658
15	88.1	72.7	727.3	500.0	382.0	2,431
16	87.5	71.7	794.2	500.0	378.8	2,137
17	86.0	70.6	806.4	500.0	375.4	1,830
18	83.8	69.7	758.7	500.0	372.7	1,572
19	81.2	68.5	598.2	500.0	369.1	1,473
20	78.6	68.7	545.2	500.0	369.7	1,428
21	76.4	68.8	454.4	454.4	328.4	1,428
22	74.3	67.6	321.1	321.1	219.1	1,428
23	72.7	66.4	220.8	220.8	153.1	1,428
24	71.5	65.3	194.9	194.9	136.8	1,428

Hour	Typical ODB (F)	Typical OWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	375.0	349.8	1,802	0.0	375.0	349.8	3,159
2	68.2	63.5	0.0	375.0	344.6	2,175	0.0	143.8	131.4	3,300
3	66.6	62.2	0.0	375.0	340.9	2,549	0.0	0.0	0.0	3,300
4	65.4	61.1	0.0	375.0	337.9	2,922	0.0	0.0	0.0	3,300
5	64.6	60.7	0.0	375.0	336.8	3,294	0.0	0.0	0.0	3,300
6	64.4	60.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	64.9	61.2	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	66.3	61.6	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	68.5	62.5	178.1	178.1	123.7	3,300	178.0	178.0	123.7	3,300
10	71.4	63.6	250.5	250.5	165.5	3,300	250.6	250.6	165.5	3,300
11	74.5	65.1	396.0	396.0	270.1	3,300	396.0	396.0	270.1	3,300
12	77.6	66.8	504.8	500.0	364.1	3,295	504.8	500.0	364.1	3,295
13	80.5	68.2	495.1	495.1	363.6	3,295	495.1	495.1	363.6	3,295

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	500.0	372.7	3,269	525.9	500.0	372.7	3,269
15	84.2	70.7	562.3	500.0	375.7	3,207	562.3	500.0	375.7	3,207
16	84.6	70.5	612.6	500.0	375.1	3,094	612.6	500.0	375.1	3,094
17	84.4	70.4	668.2	500.0	374.8	2,926	668.2	500.0	374.8	2,926
18	83.6	70.7	640.3	500.0	375.7	2,786	640.3	500.0	375.7	2,786
19	82.4	70.7	496.1	496.1	372.0	2,786	496.1	496.1	372.0	2,786
20	80.8	71.9	476.3	476.3	357.1	2,786	476.3	476.3	357.1	2,786
21	78.9	72.4	433.7	433.7	320.1	2,786	433.7	433.7	320.1	2,786
22	76.8	71.1	330.5	330.5	233.2	2,786	330.5	330.5	233.2	2,786
23	74.5	69.3	243.3	243.3	171.6	2,786	243.3	243.3	171.6	2,786
24	72.2	67.2	198.3	198.3	141.7	2,786	198.3	198.3	141.7	2,786

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	375.0	349.8	3,159	0.0	375.0	349.8	3,159
2	68.2	63.5	0.0	143.8	131.4	3,300	0.0	143.8	131.4	3,300
3	66.6	62.2	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
4	65.4	61.1	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
5	64.6	60.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
6	64.4	60.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	64.9	61.2	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	66.3	61.6	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	68.5	62.5	178.0	178.0	123.7	3,300	178.0	178.0	123.7	3,300
10	71.4	63.6	250.6	250.6	165.5	3,300	250.6	250.6	165.5	3,300
11	74.5	65.1	396.0	396.0	270.1	3,300	396.0	396.0	270.1	3,300
12	77.6	66.8	504.8	500.0	364.1	3,295	504.8	500.0	364.1	3,295
13	80.5	68.2	495.1	495.1	363.6	3,295	495.1	495.1	363.6	3,295
14	82.7	69.7	525.9	500.0	372.7	3,269	525.9	500.0	372.7	3,269
15	84.2	70.7	562.3	500.0	375.7	3,207	562.3	500.0	375.7	3,207
16	84.6	70.5	612.6	500.0	375.1	3,094	612.6	500.0	375.1	3,094
17	84.4	70.4	668.2	500.0	374.8	2,926	668.2	500.0	374.8	2,926
18	83.6	70.7	640.3	500.0	375.7	2,786	640.3	500.0	375.7	2,786
19	82.4	70.7	496.1	496.1	372.0	2,786	496.1	496.1	372.0	2,786
20	80.8	71.9	476.3	476.3	357.1	2,786	476.3	476.3	357.1	2,786
21	78.9	72.4	433.7	433.7	320.1	2,786	433.7	433.7	320.1	2,786
22	76.8	71.1	330.5	330.5	233.2	2,786	330.5	330.5	233.2	2,786
23	74.5	69.3	243.3	243.3	171.6	2,786	243.3	243.3	171.6	2,786
24	72.2	67.2	198.3	198.3	141.7	2,786	198.3	198.3	141.7	2,786

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	0.0	375.0	336.8	3,159
2	63.3	59.8	0.0	143.8	125.9	3,300
3	62.4	59.2	0.0	0.0	0.0	3,300
4	61.8	58.5	0.0	0.0	0.0	3,300
5	61.6	58.3	0.0	0.0	0.0	3,300
6	62.0	58.7	0.0	0.0	0.0	3,300
7	63.1	59.8	0.0	0.0	0.0	3,300
8	64.9	61.3	0.0	0.0	0.0	3,300
9	67.5	62.3	207.6	207.6	138.7	3,300
10	70.6	63.4	305.6	305.6	200.3	3,300
11	74.0	65.1	491.7	491.7	351.8	3,300
12	77.3	66.6	611.3	500.0	363.6	3,189
13	79.7	68.1	579.7	500.0	367.9	3,109
14	81.3	68.9	596.3	500.0	370.3	3,013
15	81.9	69.3	623.8	500.0	371.5	2,889
16	81.3	68.8	684.1	500.0	370.0	2,705
17	79.9	68.2	694.6	500.0	368.2	2,510
18	77.7	67.0	653.5	500.0	364.7	2,357
19	75.0	66.9	506.2	500.0	364.4	2,351
20	72.4	66.6	369.5	369.5	252.8	2,351
21	70.2	65.3	283.2	283.2	188.9	2,351
22	68.1	63.7	169.8	169.8	121.2	2,351
23	66.5	62.5	112.6	112.6	92.2	2,351
24	65.3	61.6	96.5	96.5	84.1	2,351

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	375.0	339.0	2,724	0.0	68.0	81.1	3,300
2	62.0	59.7	0.0	375.0	334.1	3,096	0.0	0.0	0.0	3,300
3	60.4	58.4	0.0	206.0	170.2	3,300	0.0	0.0	0.0	3,300
4	59.2	57.1	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
5	58.4	56.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
6	58.2	56.1	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	58.7	56.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	60.1	57.9	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	62.4	58.6	79.2	79.2	75.2	3,300	79.2	79.2	75.2	3,300
10	65.2	59.6	142.2	142.2	102.8	3,300	142.9	142.9	103.1	3,300
11	68.3	61.1	275.3	275.3	176.5	3,300	275.3	275.3	176.5	3,300
12	71.5	62.7	415.0	415.0	279.9	3,300	415.0	415.0	279.9	3,300
13	74.3	64.6	413.9	413.9	283.4	3,300	414.3	414.3	283.7	3,300

COLD THERMAL STORAGE - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	456.6	322.9	3,300	456.6	456.6	322.8	3,300
15	78.0	67.1	465.5	465.5	333.6	3,300	465.5	465.5	333.6	3,300
16	78.5	67.5	514.5	500.0	366.2	3,285	514.5	500.0	366.2	3,285
17	78.2	67.9	550.9	500.0	367.3	3,235	550.9	500.0	367.3	3,235
18	77.5	68.0	499.0	499.0	366.7	3,235	499.0	499.0	366.7	3,235
19	76.3	69.3	379.7	379.7	267.0	3,235	379.7	379.7	267.0	3,235
20	74.7	70.0	348.0	348.0	244.0	3,235	348.0	348.0	244.0	3,235
21	72.7	69.0	290.0	290.0	200.3	3,235	290.0	290.0	200.3	3,235
22	70.6	67.3	190.0	190.0	137.3	3,235	190.0	190.0	137.3	3,235
23	68.3	65.4	121.4	121.4	99.6	3,235	121.4	121.4	99.6	3,235
24	66.1	63.6	104.2	104.2	89.6	3,235	104.2	104.2	89.6	3,235

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	68.0	81.1	3,300	0.0	68.0	81.1	3,300
2	62.0	59.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
3	60.4	58.4	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
4	59.2	57.1	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
5	58.4	56.3	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
6	58.2	56.1	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
7	58.7	56.7	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
8	60.1	57.9	0.0	0.0	0.0	3,300	0.0	0.0	0.0	3,300
9	62.4	58.6	79.2	79.2	75.2	3,300	79.2	79.2	75.2	3,300
10	65.2	59.6	142.9	142.9	103.1	3,300	142.9	142.9	103.1	3,300
11	68.3	61.1	275.3	275.3	176.5	3,300	275.3	275.3	176.5	3,300
12	71.5	62.7	415.0	415.0	279.9	3,300	415.0	415.0	279.9	3,300
13	74.3	64.6	414.3	414.3	283.7	3,300	414.3	414.3	283.7	3,300
14	76.6	66.0	456.6	456.6	322.8	3,300	456.6	456.6	322.8	3,300
15	78.0	67.1	465.5	465.5	333.6	3,300	465.5	465.5	333.6	3,300
16	78.5	67.5	514.5	500.0	366.2	3,285	514.5	500.0	366.2	3,285
17	78.2	67.9	550.9	500.0	367.3	3,235	550.9	500.0	367.3	3,235
18	77.5	68.0	499.0	499.0	366.7	3,235	499.0	499.0	366.7	3,235
19	76.3	69.3	379.7	379.7	267.0	3,235	379.7	379.7	267.0	3,235
20	74.7	70.0	348.0	348.0	244.0	3,235	348.0	348.0	244.0	3,235
21	72.7	69.0	290.0	290.0	200.3	3,235	290.0	290.0	200.3	3,235
22	70.6	67.3	190.0	190.0	137.3	3,235	190.0	190.0	137.3	3,235
23	68.3	65.4	121.4	121.4	99.6	3,235	121.4	121.4	99.6	3,235
24	66.1	63.6	104.2	104.2	89.6	3,235	104.2	104.2	89.6	3,235

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COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	4,000
2	67.8	64.4	0.0	0.0	0.0	4,000
3	67.0	63.5	0.0	0.0	0.0	4,000
4	66.4	62.7	0.0	0.0	0.0	4,000
5	66.3	62.7	0.0	0.0	0.0	4,000
6	66.6	63.7	0.0	0.0	0.0	4,000
7	67.6	64.5	0.0	0.0	0.0	4,000
8	69.3	65.1	0.0	0.0	0.0	4,000
9	71.8	66.0	0.0	0.0	0.0	4,000
10	74.6	67.6	109.2	109.2	91.9	4,000
11	77.8	69.8	241.8	241.8	169.6	4,000
12	80.9	71.9	384.5	384.5	281.8	4,000
13	83.2	73.5	353.7	353.7	259.3	4,000
14	84.7	74.4	435.0	435.0	334.2	4,000
15	85.3	74.6	542.1	450.0	349.3	3,908
16	84.7	74.5	682.4	450.0	349.0	3,676
17	83.4	73.5	806.8	450.0	346.1	3,319
18	81.3	71.5	768.0	450.0	340.4	3,001
19	78.8	70.1	652.3	450.0	336.5	2,798
20	76.3	70.0	591.1	450.0	336.2	2,657
21	74.2	69.5	546.4	450.0	334.9	2,561
22	72.3	68.7	422.4	422.4	307.4	2,561
23	70.8	67.1	0.0	345.0	327.4	2,904
24	69.7	65.8	0.0	345.0	323.8	3,247

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	345.0	322.5	3,589	0.0	345.0	322.5	3,897
2	66.0	63.9	0.0	345.0	318.7	3,931	0.0	106.1	103.7	4,000
3	64.6	62.4	0.0	72.0	80.8	4,000	0.0	0.0	0.0	4,000
4	63.7	61.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
5	63.0	60.8	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
6	62.8	61.2	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	63.4	61.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	65.1	62.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	67.6	63.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	70.7	65.2	286.9	286.9	191.4	4,000	286.9	286.9	191.5	4,000
11	74.0	67.5	432.3	432.3	313.2	4,000	432.3	432.3	313.2	4,000
12	77.1	69.8	557.6	450.0	335.7	3,892	557.6	450.0	335.7	3,892
13	79.6	71.6	535.2	450.0	340.7	3,807	535.2	450.0	340.7	3,807

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	450.0	343.8	3,723	534.2	450.0	343.8	3,723
15	81.8	72.8	561.4	450.0	344.1	3,612	561.4	450.0	344.1	3,612
16	81.6	73.1	609.6	450.0	344.9	3,452	609.6	450.0	344.9	3,452
17	81.0	72.7	678.8	450.0	343.8	3,223	678.8	450.0	343.8	3,223
18	80.0	71.6	665.1	450.0	340.7	3,008	665.1	450.0	340.7	3,008
19	78.7	71.3	542.0	450.0	339.8	2,916	542.0	450.0	339.8	2,916
20	77.1	72.0	496.4	450.0	341.8	2,870	496.4	450.0	341.8	2,870
21	75.3	71.8	448.1	448.1	339.4	2,870	448.1	448.1	339.4	2,870
22	73.3	71.0	338.5	338.5	241.3	2,870	338.5	338.5	241.3	2,870
23	71.3	68.9	0.0	345.0	332.5	3,212	0.0	345.0	332.5	3,212
24	69.4	66.8	0.0	345.0	326.6	3,555	0.0	345.0	326.6	3,555

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	345.0	322.5	3,897	0.0	345.0	322.5	3,897
2	66.0	63.9	0.0	106.1	103.7	4,000	0.0	106.1	103.7	4,000
3	64.6	62.4	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
4	63.7	61.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
5	63.0	60.8	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
6	62.8	61.2	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	63.4	61.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	65.1	62.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	67.6	63.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	70.7	65.2	286.9	286.9	191.5	4,000	286.9	286.9	191.5	4,000
11	74.0	67.5	432.3	432.3	313.2	4,000	432.3	432.3	313.2	4,000
12	77.1	69.8	557.6	450.0	335.7	3,892	557.6	450.0	335.7	3,892
13	79.6	71.6	535.2	450.0	340.7	3,807	535.2	450.0	340.7	3,807
14	81.3	72.7	534.2	450.0	343.8	3,723	534.2	450.0	343.8	3,723
15	81.8	72.8	561.4	450.0	344.1	3,612	561.4	450.0	344.1	3,612
16	81.6	73.1	609.6	450.0	344.9	3,452	609.6	450.0	344.9	3,452
17	81.0	72.7	678.8	450.0	343.8	3,223	678.8	450.0	343.8	3,223
18	80.0	71.6	665.1	450.0	340.7	3,008	665.1	450.0	340.7	3,008
19	78.7	71.3	542.0	450.0	339.8	2,916	542.0	450.0	339.8	2,916
20	77.1	72.0	496.4	450.0	341.8	2,870	496.4	450.0	341.8	2,870
21	75.3	71.8	448.1	448.1	339.4	2,870	448.1	448.1	339.4	2,870
22	73.3	71.0	338.5	338.5	241.3	2,870	338.5	338.5	241.3	2,870
23	71.3	68.9	0.0	345.0	332.5	3,212	0.0	345.0	332.5	3,212
24	69.4	66.8	0.0	345.0	326.6	3,555	0.0	345.0	326.6	3,555

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	0.0	345.0	332.2	3,897
2	72.3	67.9	0.0	106.1	108.7	4,000
3	71.4	67.2	0.0	0.0	0.0	4,000
4	70.7	67.0	0.0	0.0	0.0	4,000
5	70.5	66.9	0.0	0.0	0.0	4,000
6	71.0	67.4	0.0	0.0	0.0	4,000
7	72.1	68.4	0.0	0.0	0.0	4,000
8	74.1	69.3	0.0	0.0	0.0	4,000
9	77.0	70.1	0.0	0.0	0.0	4,000
10	80.4	71.4	494.4	450.0	340.1	3,956
11	84.2	73.3	672.3	450.0	345.5	3,733
12	87.8	75.5	775.6	450.0	351.9	3,408
13	90.5	76.5	733.0	450.0	354.9	3,125
14	92.3	76.8	763.3	450.0	355.8	2,811
15	93.0	77.0	805.4	450.0	356.4	2,456
16	92.3	76.7	891.8	450.0	355.5	2,014
17	90.8	75.3	889.6	450.0	351.3	1,575
18	88.3	74.2	860.2	450.0	348.1	1,164
19	85.4	72.9	714.1	450.0	344.4	900
20	82.4	73.4	680.5	450.0	345.8	670
21	80.0	73.0	641.2	450.0	344.6	479
22	77.7	72.3	559.5	450.0	342.6	369
23	75.9	70.6	0.0	345.0	337.4	714
24	74.6	69.4	0.0	345.0	333.9	1,058

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	345.0	338.6	1,402	0.0	345.0	338.6	2,637
2	71.9	68.8	0.0	345.0	332.2	1,746	0.0	345.0	332.2	2,980
3	69.9	67.0	0.0	345.0	327.1	2,090	0.0	345.0	327.1	3,323
4	68.3	65.9	0.0	345.0	324.1	2,433	0.0	345.0	324.1	3,665
5	67.4	65.2	0.0	345.0	322.2	2,776	0.0	337.7	313.6	4,000
6	67.0	64.9	0.0	345.0	321.4	3,119	0.0	0.0	0.0	4,000
7	67.5	65.3	0.0	345.0	322.5	3,462	0.0	0.0	0.0	4,000
8	68.8	65.6	0.0	345.0	323.3	3,804	0.0	0.0	0.0	4,000
9	70.9	65.7	0.0	199.2	175.6	4,000	0.0	0.0	0.0	4,000
10	73.6	66.5	305.3	305.3	206.9	4,000	305.3	305.3	206.9	4,000
11	76.7	67.9	454.0	450.0	330.6	3,996	454.0	450.0	330.6	3,996
12	79.9	69.9	581.5	450.0	336.0	3,864	581.5	450.0	336.0	3,864
13	83.0	71.3	563.2	450.0	339.8	3,751	563.2	450.0	339.8	3,751

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	450.0	343.2	3,604	597.7	450.0	343.2	3,604
15	87.8	73.9	654.3	450.0	347.2	3,399	654.3	450.0	347.2	3,399
16	89.1	75.3	737.3	450.0	351.3	3,112	737.3	450.0	351.3	3,112
17	89.5	75.5	810.6	450.0	351.9	2,751	810.6	450.0	351.9	2,751
18	89.2	76.2	803.8	450.0	354.0	2,398	803.8	450.0	354.0	2,398
19	88.3	76.7	700.3	450.0	355.5	2,147	700.3	450.0	355.5	2,147
20	86.7	78.6	684.0	450.0	361.3	1,913	684.0	450.0	361.3	1,913
21	84.7	78.8	656.5	450.0	361.9	1,707	656.5	450.0	361.9	1,707
22	82.3	78.0	549.7	450.0	359.5	1,607	549.7	450.0	359.5	1,607
23	79.6	75.4	0.0	345.0	351.9	1,951	0.0	345.0	351.9	1,951
24	76.9	73.0	0.0	345.0	344.6	2,294	0.0	345.0	344.6	2,294

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	345.0	338.6	2,637	0.0	345.0	338.6	2,637
2	71.9	68.8	0.0	345.0	332.2	2,980	0.0	345.0	332.2	2,980
3	69.9	67.0	0.0	345.0	327.1	3,323	0.0	345.0	327.1	3,323
4	68.3	65.9	0.0	345.0	324.1	3,665	0.0	345.0	324.1	3,665
5	67.4	65.2	0.0	337.7	313.6	4,000	0.0	337.7	313.6	4,000
6	67.0	64.9	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	67.5	65.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	68.8	65.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	70.9	65.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	73.6	66.5	305.3	305.3	206.9	4,000	305.3	305.3	206.9	4,000
11	76.7	67.9	454.0	450.0	330.6	3,996	454.0	450.0	330.6	3,996
12	79.9	69.9	581.5	450.0	336.0	3,864	581.5	450.0	336.0	3,864
13	83.0	71.3	563.2	450.0	339.8	3,751	563.2	450.0	339.8	3,751
14	85.7	72.5	597.7	450.0	343.2	3,604	597.7	450.0	343.2	3,604
15	87.8	73.9	654.3	450.0	347.2	3,399	654.3	450.0	347.2	3,399
16	89.1	75.3	737.3	450.0	351.3	3,112	737.3	450.0	351.3	3,112
17	89.5	75.5	810.6	450.0	351.9	2,751	810.6	450.0	351.9	2,751
18	89.2	76.2	803.8	450.0	354.0	2,398	803.8	450.0	354.0	2,398
19	88.3	76.7	700.3	450.0	355.5	2,147	700.3	450.0	355.5	2,147
20	86.7	78.6	684.0	450.0	361.3	1,913	684.0	450.0	361.3	1,913
21	84.7	78.8	656.5	450.0	361.9	1,707	656.5	450.0	361.9	1,707
22	82.3	78.0	549.7	450.0	359.5	1,607	549.7	450.0	359.5	1,607
23	79.6	75.4	0.0	345.0	351.9	1,951	0.0	345.0	351.9	1,951
24	76.9	73.0	0.0	345.0	344.6	2,294	0.0	345.0	344.6	2,294

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

August

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	0.0	345.0	320.3	2,637
2	69.5	63.5	0.0	345.0	317.7	2,980
3	68.7	63.0	0.0	345.0	316.4	3,323
4	68.1	62.4	0.0	345.0	314.8	3,665
5	67.9	62.6	0.0	337.7	306.9	4,000
6	68.3	63.2	0.0	0.0	0.0	4,000
7	69.3	64.1	0.0	0.0	0.0	4,000
8	71.1	64.9	0.0	0.0	0.0	4,000
9	73.7	66.1	0.0	0.0	0.0	4,000
10	76.8	67.2	406.9	406.9	289.9	4,000
11	80.2	68.9	583.6	450.0	333.2	3,866
12	83.4	70.6	695.3	450.0	337.9	3,621
13	85.8	71.5	664.3	450.0	340.4	3,407
14	87.5	72.5	698.6	450.0	343.2	3,158
15	88.1	72.7	727.3	450.0	343.8	2,881
16	87.5	71.7	794.2	450.0	341.0	2,537
17	86.0	70.6	806.4	450.0	337.9	2,180
18	83.8	69.7	758.7	450.0	335.4	1,872
19	81.2	68.5	598.2	450.0	332.2	1,723
20	78.6	68.7	545.2	450.0	332.7	1,628
21	76.4	68.8	454.4	450.0	333.0	1,624
22	74.3	67.6	321.1	321.1	220.8	1,624
23	72.7	66.4	0.0	345.0	325.5	1,967
24	71.5	65.3	0.0	345.0	322.5	2,311

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	345.0	322.5	2,654	0.0	249.7	220.1	4,000
2	68.2	63.5	0.0	345.0	317.7	2,997	0.0	0.0	0.0	4,000
3	66.6	62.2	0.0	345.0	314.3	3,339	0.0	0.0	0.0	4,000
4	65.4	61.1	0.0	345.0	311.6	3,682	0.0	0.0	0.0	4,000
5	64.6	60.7	0.0	321.2	283.6	4,000	0.0	0.0	0.0	4,000
6	64.4	60.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	64.9	61.2	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	66.3	61.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	68.5	62.5	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	71.4	63.6	250.5	250.5	164.5	4,000	250.6	250.6	164.5	4,000
11	74.5	65.1	396.0	396.0	275.6	4,000	396.0	396.0	275.6	4,000
12	77.6	66.8	504.8	450.0	327.7	3,945	504.8	450.0	327.7	3,945
13	80.5	68.2	495.1	450.0	331.4	3,900	495.1	450.0	331.4	3,900

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	450.0	335.4	3,824	525.9	450.0	335.4	3,824
15	84.2	70.7	562.3	450.0	338.2	3,712	562.3	450.0	338.2	3,712
16	84.6	70.5	612.6	450.0	337.6	3,549	612.6	450.0	337.6	3,549
17	84.4	70.4	668.2	450.0	337.3	3,331	668.2	450.0	337.3	3,331
18	83.6	70.7	640.3	450.0	338.2	3,141	640.3	450.0	338.2	3,141
19	82.4	70.7	496.1	450.0	338.2	3,095	496.1	450.0	338.2	3,095
20	80.8	71.9	476.3	450.0	341.5	3,069	476.3	450.0	341.5	3,069
21	78.9	72.4	433.7	433.7	327.5	3,069	433.7	433.7	327.5	3,069
22	76.8	71.1	330.5	330.5	235.2	3,069	330.5	330.5	235.2	3,069
23	74.5	69.3	0.0	345.0	333.7	3,411	0.0	345.0	333.7	3,411
24	72.2	67.2	0.0	345.0	327.7	3,753	0.0	345.0	327.7	3,753

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	249.7	220.1	4,000	0.0	249.7	220.1	4,000
2	68.2	63.5	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
3	66.6	62.2	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
4	65.4	61.1	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
5	64.6	60.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
6	64.4	60.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	64.9	61.2	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	66.3	61.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	68.5	62.5	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	71.4	63.6	250.6	250.6	164.5	4,000	250.6	250.6	164.5	4,000
11	74.5	65.1	396.0	396.0	275.6	4,000	396.0	396.0	275.6	4,000
12	77.6	66.8	504.8	450.0	327.7	3,945	504.8	450.0	327.7	3,945
13	80.5	68.2	495.1	450.0	331.4	3,900	495.1	450.0	331.4	3,900
14	82.7	69.7	525.9	450.0	335.4	3,824	525.9	450.0	335.4	3,824
15	84.2	70.7	562.3	450.0	338.2	3,712	562.3	450.0	338.2	3,712
16	84.6	70.5	612.6	450.0	337.6	3,549	612.6	450.0	337.6	3,549
17	84.4	70.4	668.2	450.0	337.3	3,331	668.2	450.0	337.3	3,331
18	83.6	70.7	640.3	450.0	338.2	3,141	640.3	450.0	338.2	3,141
19	82.4	70.7	496.1	450.0	338.2	3,095	496.1	450.0	338.2	3,095
20	80.8	71.9	476.3	450.0	341.5	3,069	476.3	450.0	341.5	3,069
21	78.9	72.4	433.7	433.7	327.5	3,069	433.7	433.7	327.5	3,069
22	76.8	71.1	330.5	330.5	235.2	3,069	330.5	330.5	235.2	3,069
23	74.5	69.3	0.0	345.0	333.7	3,411	0.0	345.0	333.7	3,411
24	72.2	67.2	0.0	345.0	327.7	3,753	0.0	345.0	327.7	3,753

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	0.0	249.7	210.8	4,000
2	63.3	59.8	0.0	0.0	0.0	4,000
3	62.4	59.2	0.0	0.0	0.0	4,000
4	61.8	58.5	0.0	0.0	0.0	4,000
5	61.6	58.3	0.0	0.0	0.0	4,000
6	62.0	58.7	0.0	0.0	0.0	4,000
7	63.1	59.8	0.0	0.0	0.0	4,000
8	64.9	61.3	0.0	0.0	0.0	4,000
9	67.5	62.3	0.0	0.0	0.0	4,000
10	70.6	63.4	305.6	305.6	201.5	4,000
11	74.0	65.1	491.7	450.0	323.4	3,958
12	77.3	66.6	611.3	450.0	327.2	3,797
13	79.7	68.1	579.7	450.0	331.1	3,667
14	81.3	68.9	596.3	450.0	333.2	3,521
15	81.9	69.3	623.8	450.0	334.3	3,347
16	81.3	68.8	684.1	450.0	333.0	3,113
17	79.9	68.2	694.6	450.0	331.4	2,868
18	77.7	67.0	653.5	450.0	328.2	2,665
19	75.0	66.9	506.2	450.0	328.0	2,609
20	72.4	66.6	369.5	369.5	256.9	2,609
21	70.2	65.3	283.2	283.2	189.1	2,609
22	68.1	63.7	169.8	169.8	117.9	2,609
23	66.5	62.5	0.0	345.0	315.1	2,952
24	65.3	61.6	0.0	345.0	312.8	3,294

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	345.0	312.6	3,637	0.0	0.0	0.0	4,000
2	62.0	59.7	0.0	345.0	308.2	3,979	0.0	0.0	0.0	4,000
3	60.4	58.4	0.0	24.4	41.0	4,000	0.0	0.0	0.0	4,000
4	59.2	57.1	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
5	58.4	56.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
6	58.2	56.1	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	58.7	56.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	60.1	57.9	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	62.4	58.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	65.2	59.6	142.2	142.2	99.2	4,000	142.9	142.9	99.5	4,000
11	68.3	61.1	275.3	275.3	176.6	4,000	275.3	275.3	176.6	4,000
12	71.5	62.7	415.0	415.0	286.6	4,000	415.0	415.0	286.6	4,000
13	74.3	64.6	413.9	413.9	290.0	4,000	414.3	414.3	290.3	4,000

COLD THERMAL STORAGE - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	DADB (F)	DAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	450.0	325.7	3,993	456.6	450.0	325.7	3,993
15	78.0	67.1	465.5	450.0	328.5	3,978	465.5	450.0	328.5	3,978
16	78.5	67.5	514.5	450.0	329.5	3,913	514.5	450.0	329.5	3,913
17	78.2	67.9	550.9	450.0	330.6	3,812	550.9	450.0	330.6	3,813
18	77.5	68.0	499.0	450.0	330.9	3,764	499.0	450.0	330.9	3,764
19	76.3	69.3	379.7	379.7	271.5	3,764	379.7	379.7	271.5	3,764
20	74.7	70.0	348.0	348.0	246.8	3,764	348.0	348.0	246.8	3,764
21	72.7	69.0	290.0	290.0	200.5	3,764	290.0	290.0	200.5	3,764
22	70.6	67.3	190.0	190.0	134.2	3,764	190.0	190.0	134.2	3,764
23	68.3	65.4	0.0	239.5	210.6	4,000	0.0	239.5	210.6	4,000
24	66.1	63.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000

	Typical		Sunday				Monday			
Hour	DADB (F)	DAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
2	62.0	59.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
3	60.4	58.4	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
4	59.2	57.1	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
5	58.4	56.3	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
6	58.2	56.1	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
7	58.7	56.7	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
8	60.1	57.9	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
9	62.4	58.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000
10	65.2	59.6	142.9	142.9	99.5	4,000	142.9	142.9	99.5	4,000
11	68.3	61.1	275.3	275.3	176.6	4,000	275.3	275.3	176.6	4,000
12	71.5	62.7	415.0	415.0	286.6	4,000	415.0	415.0	286.6	4,000
13	74.3	64.6	414.3	414.3	290.3	4,000	414.3	414.3	290.3	4,000
14	76.6	66.0	456.6	450.0	325.7	3,993	456.6	450.0	325.7	3,993
15	78.0	67.1	465.5	450.0	328.5	3,978	465.5	450.0	328.5	3,978
16	78.5	67.5	514.5	450.0	329.5	3,913	514.5	450.0	329.5	3,913
17	78.2	67.9	550.9	450.0	330.6	3,813	550.9	450.0	330.6	3,813
18	77.5	68.0	499.0	450.0	330.9	3,764	499.0	450.0	330.9	3,764
19	76.3	69.3	379.7	379.7	271.5	3,764	379.7	379.7	271.5	3,764
20	74.7	70.0	348.0	348.0	246.8	3,764	348.0	348.0	246.8	3,764
21	72.7	69.0	290.0	290.0	200.5	3,764	290.0	290.0	200.5	3,764
22	70.6	67.3	190.0	190.0	134.2	3,764	190.0	190.0	134.2	3,764
23	68.3	65.4	0.0	239.5	210.6	4,000	0.0	239.5	210.6	4,000
24	66.1	63.6	0.0	0.0	0.0	4,000	0.0	0.0	0.0	4,000

ECO IT-3

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	6,000
2	67.8	64.4	0.0	0.0	0.0	6,000
3	67.0	63.5	0.0	0.0	0.0	6,000
4	66.4	62.7	0.0	0.0	0.0	6,000
5	66.3	62.7	0.0	0.0	0.0	6,000
6	66.6	63.7	0.0	0.0	0.0	6,000
7	67.6	64.5	0.0	0.0	0.0	6,000
8	69.3	65.1	0.0	0.0	0.0	6,000
9	71.8	66.0	65.3	65.3	89.9	6,000
10	74.6	67.6	109.2	109.2	125.0	6,000
11	77.8	69.8	241.8	241.8	192.9	6,000
12	80.9	71.9	384.5	0.0	0.0	5,611
13	83.2	73.5	353.7	0.0	0.0	5,252
14	84.7	74.4	435.0	0.0	0.0	4,813
15	85.3	74.6	542.1	0.0	0.0	4,267
16	84.7	74.5	682.4	0.0	0.0	3,582
17	83.4	73.5	806.8	0.0	0.0	2,772
18	81.3	71.5	768.0	768.0	573.3	2,772
19	78.8	70.1	652.3	652.3	465.8	2,772
20	76.3	70.0	591.1	591.1	416.2	2,772
21	74.2	69.5	546.4	546.4	380.5	2,772
22	72.3	68.7	422.4	422.4	293.5	2,772
23	70.8	67.1	246.2	246.2	189.3	2,772
24	69.7	65.8	170.5	170.5	149.8	2,772

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	625.0	584.5	3,395	0.0	625.0	584.5	3,124
2	66.0	63.9	0.0	625.0	577.8	4,017	0.0	625.0	577.8	3,747
3	64.6	62.4	0.0	625.0	570.7	4,639	0.0	625.0	570.7	4,369
4	63.7	61.3	0.0	625.0	565.7	5,260	0.0	625.0	565.7	4,990
5	63.0	60.8	0.0	625.0	563.5	5,881	0.0	625.0	563.5	5,611
6	62.8	61.2	0.0	123.9	140.5	6,000	0.0	393.4	330.8	6,000
7	63.4	61.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	65.1	62.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	67.6	63.3	220.8	220.8	168.8	6,000	220.8	220.8	168.8	6,000
10	70.7	65.2	286.9	286.9	206.1	6,000	286.9	286.9	206.1	6,000
11	74.0	67.5	432.3	432.3	295.5	6,000	432.3	432.3	295.5	6,000
12	77.1	69.8	557.6	0.0	0.0	5,438	557.6	0.0	0.0	5,438
13	79.6	71.6	535.2	0.0	0.0	4,898	535.2	0.0	0.0	4,898

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	0.0	0.0	4,360	534.2	0.0	0.0	4,360
15	81.8	72.8	561.4	0.0	0.0	3,795	561.4	0.0	0.0	3,795
16	81.6	73.1	609.6	0.0	0.0	3,182	609.6	0.0	0.0	3,182
17	81.0	72.7	678.8	0.0	0.0	2,501	678.8	0.0	0.0	2,501
18	80.0	71.6	665.1	665.1	482.6	2,501	665.1	665.1	482.6	2,501
19	78.7	71.3	542.0	542.0	383.5	2,501	542.0	542.0	383.5	2,501
20	77.1	72.0	496.4	496.4	353.5	2,501	496.4	496.4	353.5	2,501
21	75.3	71.8	448.1	448.1	320.4	2,501	448.1	448.1	320.4	2,501
22	73.3	71.0	338.5	338.5	249.7	2,501	338.5	338.5	249.7	2,501
23	71.3	68.9	227.4	227.4	183.5	2,501	227.4	227.4	183.5	2,501
24	69.4	66.8	158.1	158.1	145.7	2,501	158.1	158.1	145.7	2,501

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	625.0	584.5	3,124	0.0	625.0	584.5	3,124
2	66.0	63.9	0.0	625.0	577.8	3,747	0.0	625.0	577.8	3,747
3	64.6	62.4	0.0	625.0	570.7	4,369	0.0	625.0	570.7	4,369
4	63.7	61.3	0.0	625.0	565.7	4,990	0.0	625.0	565.7	4,990
5	63.0	60.8	0.0	625.0	563.5	5,611	0.0	625.0	563.5	5,611
6	62.8	61.2	0.0	393.4	330.8	6,000	0.0	393.4	330.8	6,000
7	63.4	61.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	65.1	62.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	67.6	63.3	220.8	220.8	168.8	6,000	220.8	220.8	168.8	6,000
10	70.7	65.2	286.9	286.9	206.1	6,000	286.9	286.9	206.1	6,000
11	74.0	67.5	432.3	432.3	295.5	6,000	432.3	432.3	295.5	6,000
12	77.1	69.8	557.6	0.0	0.0	5,438	557.6	0.0	0.0	5,438
13	79.6	71.6	535.2	0.0	0.0	4,898	535.2	0.0	0.0	4,898
14	81.3	72.7	534.2	0.0	0.0	4,360	534.2	0.0	0.0	4,360
15	81.8	72.8	561.4	0.0	0.0	3,795	561.4	0.0	0.0	3,795
16	81.6	73.1	609.6	0.0	0.0	3,182	609.6	0.0	0.0	3,182
17	81.0	72.7	678.8	0.0	0.0	2,501	678.8	0.0	0.0	2,501
18	80.0	71.6	665.1	665.1	482.6	2,501	665.1	665.1	482.6	2,501
19	78.7	71.3	542.0	542.0	383.5	2,501	542.0	542.0	383.5	2,501
20	77.1	72.0	496.4	496.4	353.5	2,501	496.4	496.4	353.5	2,501
21	75.3	71.8	448.1	448.1	320.4	2,501	448.1	448.1	320.4	2,501
22	73.3	71.0	338.5	338.5	249.7	2,501	338.5	338.5	249.7	2,501
23	71.3	68.9	227.4	227.4	183.5	2,501	227.4	227.4	183.5	2,501
24	69.4	66.8	158.1	158.1	145.7	2,501	158.1	158.1	145.7	2,501

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	73.4	68.8	0.0	625.0	602.2	3,124
2	72.3	67.9	0.0	625.0	597.5	3,747
3	71.4	67.2	0.0	625.0	594.0	4,369
4	70.7	67.0	0.0	625.0	593.0	4,990
5	70.5	66.9	0.0	625.0	592.5	5,611
6	71.0	67.4	0.0	393.4	352.3	6,000
7	72.1	68.4	0.0	0.0	0.0	6,000
8	74.1	69.3	1.4	0.0	0.0	6,000
9	77.0	70.1	420.6	420.6	297.0	6,000
10	80.4	71.4	494.4	494.4	349.9	6,000
11	84.2	73.3	672.3	672.3	496.1	6,000
12	87.8	75.5	775.6	0.0	0.0	5,220
13	90.5	76.5	733.0	0.0	0.0	4,483
14	92.3	76.8	763.3	0.0	0.0	3,716
15	93.0	77.0	805.4	0.0	0.0	2,907
16	92.3	76.7	891.8	0.0	0.0	2,013
17	90.8	75.3	889.6	0.0	0.0	1,122
18	88.3	74.2	860.2	810.0	626.6	1,072
19	85.4	72.9	714.1	714.1	530.9	1,072
20	82.4	73.4	680.5	680.5	503.6	1,072
21	80.0	73.0	641.2	641.2	468.4	1,072
22	77.7	72.3	559.5	559.5	400.3	1,072
23	75.9	70.6	426.3	426.3	302.2	1,072
24	74.6	69.4	280.2	280.2	212.6	1,072

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	625.0	613.7	1,696	0.0	625.0	613.7	2,657
2	71.9	68.8	0.0	625.0	602.2	2,319	0.0	625.0	602.2	3,280
3	69.9	67.0	0.0	625.0	593.0	2,943	0.0	625.0	593.0	3,902
4	68.3	65.9	0.0	625.0	587.5	3,565	0.0	625.0	587.5	4,524
5	67.4	65.2	0.0	625.0	584.0	4,187	0.0	625.0	584.0	5,146
6	67.0	64.9	0.0	625.0	582.6	4,809	0.0	625.0	582.6	5,767
7	67.5	65.3	0.0	625.0	584.5	5,430	0.0	238.1	222.6	6,000
8	68.8	65.6	0.0	574.1	527.1	6,000	0.0	0.0	0.0	6,000
9	70.9	65.7	248.7	248.7	187.6	6,000	248.7	248.7	187.6	6,000
10	73.6	66.5	305.3	305.3	219.1	6,000	305.3	305.3	219.1	6,000
11	76.7	67.9	454.0	454.0	310.6	6,000	454.0	454.0	310.6	6,000
12	79.9	69.9	581.5	0.0	0.0	5,414	581.5	0.0	0.0	5,414
13	83.0	71.3	563.2	0.0	0.0	4,846	563.2	0.0	0.0	4,846

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	0.0	0.0	4,245	597.7	0.0	0.0	4,245
15	87.8	73.9	654.3	0.0	0.0	3,587	654.3	0.0	0.0	3,587
16	89.1	75.3	737.3	0.0	0.0	2,847	737.3	0.0	0.0	2,847
17	89.5	75.5	810.6	0.0	0.0	2,034	810.6	0.0	0.0	2,034
18	89.2	76.2	803.8	803.8	631.1	2,034	803.8	803.8	631.1	2,034
19	88.3	76.7	700.3	700.3	536.1	2,034	700.3	700.3	536.1	2,034
20	86.7	78.6	684.0	684.0	530.1	2,034	684.0	684.0	530.1	2,034
21	84.7	78.8	656.5	656.5	506.4	2,034	656.5	656.5	506.4	2,034
22	82.3	78.0	549.7	549.7	416.3	2,034	549.7	549.7	416.3	2,034
23	79.6	75.4	419.7	419.7	313.8	2,034	419.7	419.7	313.8	2,034
24	76.9	73.0	325.9	325.9	247.6	2,034	325.9	325.9	247.6	2,034

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	625.0	613.7	2,657	0.0	625.0	613.7	2,657
2	71.9	68.8	0.0	625.0	602.2	3,280	0.0	625.0	602.2	3,280
3	69.9	67.0	0.0	625.0	593.0	3,902	0.0	625.0	593.0	3,902
4	68.3	65.9	0.0	625.0	587.5	4,524	0.0	625.0	587.5	4,524
5	67.4	65.2	0.0	625.0	584.0	5,146	0.0	625.0	584.0	5,146
6	67.0	64.9	0.0	625.0	582.6	5,767	0.0	625.0	582.6	5,767
7	67.5	65.3	0.0	238.1	222.6	6,000	0.0	238.1	222.6	6,000
8	68.8	65.6	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	70.9	65.7	248.7	248.7	187.6	6,000	248.7	248.7	187.6	6,000
10	73.6	66.5	305.3	305.3	219.1	6,000	305.3	305.3	219.1	6,000
11	76.7	67.9	454.0	454.0	310.6	6,000	454.0	454.0	310.6	6,000
12	79.9	69.9	581.5	0.0	0.0	5,414	581.5	0.0	0.0	5,414
13	83.0	71.3	563.2	0.0	0.0	4,846	563.2	0.0	0.0	4,846
14	85.7	72.5	597.7	0.0	0.0	4,245	597.7	0.0	0.0	4,245
15	87.8	73.9	654.3	0.0	0.0	3,587	654.3	0.0	0.0	3,587
16	89.1	75.3	737.3	0.0	0.0	2,847	737.3	0.0	0.0	2,847
17	89.5	75.5	810.6	0.0	0.0	2,034	810.6	0.0	0.0	2,034
18	89.2	76.2	803.8	803.8	631.1	2,034	803.8	803.8	631.1	2,034
19	88.3	76.7	700.3	700.3	536.1	2,034	700.3	700.3	536.1	2,034
20	86.7	78.6	684.0	684.0	530.1	2,034	684.0	684.0	530.1	2,034
21	84.7	78.8	656.5	656.5	506.4	2,034	656.5	656.5	506.4	2,034
22	82.3	78.0	549.7	549.7	416.3	2,034	549.7	549.7	416.3	2,034
23	79.6	75.4	419.7	419.7	313.8	2,034	419.7	419.7	313.8	2,034
24	76.9	73.0	325.9	325.9	247.6	2,034	325.9	325.9	247.6	2,034

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

	Design		Design			
Hour	ODB (F)	OWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.5	64.5	0.0	625.0	580.6	2,657
2	69.5	63.5	0.0	625.0	575.9	3,280
3	68.7	63.0	0.0	625.0	573.5	3,902
4	68.1	62.4	0.0	625.0	570.7	4,524
5	67.9	62.6	0.0	625.0	571.6	5,146
6	68.3	63.2	0.0	625.0	574.4	5,767
7	69.3	64.1	0.0	238.1	219.5	6,000
8	71.1	64.9	0.0	0.0	0.0	6,000
9	73.7	66.1	328.4	328.4	230.7	6,000
10	76.8	67.2	406.9	406.9	279.1	6,000
11	80.2	68.9	583.6	583.6	406.3	6,000
12	83.4	70.6	695.3	0.0	0.0	5,300
13	85.8	71.5	664.3	0.0	0.0	4,631
14	87.5	72.5	698.6	0.0	0.0	3,929
15	88.1	72.7	727.3	0.0	0.0	3,199
16	87.5	71.7	794.2	0.0	0.0	2,402
17	86.0	70.6	806.4	0.0	0.0	1,593
18	83.8	69.7	758.7	758.7	556.3	1,593
19	81.2	68.5	598.2	598.2	416.2	1,593
20	78.6	68.7	545.2	545.2	376.8	1,593
21	76.4	68.8	454.4	454.4	313.9	1,593
22	74.3	67.6	321.1	321.1	230.6	1,593
23	72.7	66.4	220.8	220.8	175.1	1,593
24	71.5	65.3	194.9	194.9	160.3	1,593

	Typical		Weekday				Saturday			
Hour	ODB (F)	OWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	625.0	584.5	2,217	0.0	625.0	584.5	3,232
2	68.2	63.5	0.0	625.0	575.9	2,840	0.0	625.0	575.9	3,854
3	66.6	62.2	0.0	625.0	569.8	3,463	0.0	625.0	569.8	4,476
4	65.4	61.1	0.0	625.0	564.8	4,085	0.0	625.0	564.8	5,097
5	64.6	60.7	0.0	625.0	563.1	4,707	0.0	625.0	563.1	5,718
6	64.4	60.7	0.0	625.0	563.1	5,328	0.0	286.3	244.1	6,000
7	64.9	61.2	0.0	625.0	565.3	5,949	0.0	0.0	0.0	6,000
8	66.3	61.6	0.0	55.7	96.4	6,000	0.0	0.0	0.0	6,000
9	68.5	62.5	178.1	178.1	147.4	6,000	178.0	178.0	147.4	6,000
10	71.4	63.6	250.5	250.5	183.9	6,000	250.6	250.6	183.9	6,000
11	74.5	65.1	396.0	396.0	266.1	6,000	396.0	396.0	266.1	6,000
12	77.6	66.8	504.8	0.0	0.0	5,490	504.8	0.0	0.0	5,490
13	80.5	68.2	495.1	0.0	0.0	4,991	495.1	0.0	0.0	4,991

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	0.0	0.0	4,461	525.9	0.0	0.0	4,461
15	84.2	70.7	562.3	0.0	0.0	3,895	562.3	0.0	0.0	3,895
16	84.6	70.5	612.6	0.0	0.0	3,279	612.6	0.0	0.0	3,279
17	84.4	70.4	668.2	0.0	0.0	2,609	668.2	0.0	0.0	2,609
18	83.6	70.7	640.3	640.3	458.3	2,609	640.3	640.3	458.3	2,609
19	82.4	70.7	496.1	496.1	348.3	2,609	496.1	496.1	348.3	2,609
20	80.8	71.9	476.3	476.3	339.5	2,609	476.3	476.3	339.5	2,609
21	78.9	72.4	433.7	433.7	313.0	2,609	433.7	433.7	313.0	2,609
22	76.8	71.1	330.5	330.5	245.3	2,609	330.5	330.5	245.3	2,609
23	74.5	69.3	243.3	243.3	192.6	2,609	243.3	243.3	192.6	2,609
24	72.2	67.2	198.3	198.3	165.6	2,609	198.3	198.3	165.6	2,609

Hour	Typical OADB (F)	Typical OAWB (F)	Sunday Cooling Load (Ton)	Sunday Chiller Load (Ton)	Sunday Chiller Demand (kW)	Sunday Storage Capacity (Ton-Hr)	Monday Cooling Load (Ton)	Monday Chiller Load (Ton)	Monday Chiller Demand (kW)	Monday Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	625.0	584.5	3,232	0.0	625.0	584.5	3,232
2	68.2	63.5	0.0	625.0	575.9	3,854	0.0	625.0	575.9	3,854
3	66.6	62.2	0.0	625.0	569.8	4,476	0.0	625.0	569.8	4,476
4	65.4	61.1	0.0	625.0	564.8	5,097	0.0	625.0	564.8	5,097
5	64.6	60.7	0.0	625.0	563.1	5,718	0.0	625.0	563.1	5,718
6	64.4	60.7	0.0	286.3	244.1	6,000	0.0	286.3	244.1	6,000
7	64.9	61.2	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	66.3	61.6	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	68.5	62.5	178.0	178.0	147.4	6,000	178.0	178.0	147.4	6,000
10	71.4	63.6	250.6	250.6	183.9	6,000	250.6	250.6	183.9	6,000
11	74.5	65.1	396.0	396.0	266.1	6,000	396.0	396.0	266.1	6,000
12	77.6	66.8	504.8	0.0	0.0	5,490	504.8	0.0	0.0	5,490
13	80.5	68.2	495.1	0.0	0.0	4,991	495.1	0.0	0.0	4,991
14	82.7	69.7	525.9	0.0	0.0	4,461	525.9	0.0	0.0	4,461
15	84.2	70.7	562.3	0.0	0.0	3,895	562.3	0.0	0.0	3,895
16	84.6	70.5	612.6	0.0	0.0	3,279	612.6	0.0	0.0	3,279
17	84.4	70.4	668.2	0.0	0.0	2,609	668.2	0.0	0.0	2,609
18	83.6	70.7	640.3	640.3	458.3	2,609	640.3	640.3	458.3	2,609
19	82.4	70.7	496.1	496.1	348.3	2,609	496.1	496.1	348.3	2,609
20	80.8	71.9	476.3	476.3	339.5	2,609	476.3	476.3	339.5	2,609
21	78.9	72.4	433.7	433.7	313.0	2,609	433.7	433.7	313.0	2,609
22	76.8	71.1	330.5	330.5	245.3	2,609	330.5	330.5	245.3	2,609
23	74.5	69.3	243.3	243.3	192.6	2,609	243.3	243.3	192.6	2,609
24	72.2	67.2	198.3	198.3	165.6	2,609	198.3	198.3	165.6	2,609

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

	Design		Design			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	64.3	60.7	0.0	625.0	563.1	3,232
2	63.3	59.8	0.0	625.0	559.1	3,854
3	62.4	59.2	0.0	625.0	556.6	4,476
4	61.8	58.5	0.0	625.0	553.7	5,097
5	61.6	58.3	0.0	625.0	552.8	5,718
6	62.0	58.7	0.0	286.3	241.9	6,000
7	63.1	59.8	0.0	0.0	0.0	6,000
8	64.9	61.3	0.0	0.0	0.0	6,000
9	67.5	62.3	207.6	207.6	160.6	6,000
10	70.6	63.4	305.6	305.6	211.4	6,000
11	74.0	65.1	491.7	491.7	327.3	6,000
12	77.3	66.6	611.3	0.0	0.0	5,384
13	79.7	68.1	579.7	0.0	0.0	4,800
14	81.3	68.9	596.3	0.0	0.0	4,200
15	81.9	69.3	623.8	0.0	0.0	3,573
16	81.3	68.8	684.1	0.0	0.0	2,886
17	79.9	68.2	694.6	0.0	0.0	2,189
18	77.7	67.0	653.5	653.5	454.4	2,189
19	75.0	66.9	506.2	506.2	342.9	2,189
20	72.4	66.6	369.5	369.5	255.3	2,189
21	70.2	65.3	283.2	283.2	204.4	2,189
22	68.1	63.7	169.8	169.8	145.8	2,189
23	66.5	62.5	112.6	112.6	119.2	2,189
24	65.3	61.6	96.5	96.5	111.5	2,189

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	625.0	566.6	2,812	0.0	625.0	566.6	3,783
2	62.0	59.7	0.0	625.0	558.7	3,435	0.0	625.0	558.7	4,404
3	60.4	58.4	0.0	625.0	553.3	4,057	0.0	625.0	553.3	5,026
4	59.2	57.1	0.0	625.0	548.0	4,679	0.0	625.0	548.0	5,647
5	58.4	56.3	0.0	625.0	544.9	5,300	0.0	357.6	294.5	6,000
6	58.2	56.1	0.0	625.0	544.2	5,921	0.0	0.0	0.0	6,000
7	58.7	56.7	0.0	84.0	116.4	6,000	0.0	0.0	0.0	6,000
8	60.1	57.9	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	62.4	58.6	79.2	79.2	100.6	6,000	79.2	79.2	100.6	6,000
10	65.2	59.6	142.2	142.2	127.6	6,000	142.9	142.9	127.9	6,000
11	68.3	61.1	275.3	275.3	190.4	6,000	275.3	275.3	190.4	6,000
12	71.5	62.7	415.0	0.0	0.0	5,580	415.0	0.0	0.0	5,580
13	74.3	64.6	413.9	0.0	0.0	5,162	414.3	0.0	0.0	5,161

COLD THERMAL STORAGE - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	0.0	0.0	4,701	456.6	0.0	0.0	4,701
15	78.0	67.1	465.5	0.0	0.0	4,232	465.5	0.0	0.0	4,231
16	78.5	67.5	514.5	0.0	0.0	3,714	514.5	0.0	0.0	3,714
17	78.2	67.9	550.9	0.0	0.0	3,160	550.9	0.0	0.0	3,160
18	77.5	68.0	499.0	499.0	341.4	3,160	499.0	499.0	341.4	3,160
19	76.3	69.3	379.7	379.7	269.3	3,160	379.7	379.7	269.3	3,160
20	74.7	70.0	348.0	348.0	252.5	3,160	348.0	348.0	252.5	3,160
21	72.7	69.0	290.0	290.0	216.9	3,160	290.0	290.0	216.9	3,160
22	70.6	67.3	190.0	190.0	161.7	3,160	190.0	190.0	161.7	3,160
23	68.3	65.4	121.4	121.4	127.0	3,160	121.4	121.4	127.0	3,160
24	66.1	63.6	104.2	104.2	117.3	3,160	104.2	104.2	117.3	3,160

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	625.0	566.6	3,782	0.0	625.0	566.6	3,782
2	62.0	59.7	0.0	625.0	558.7	4,404	0.0	625.0	558.7	4,404
3	60.4	58.4	0.0	625.0	553.3	5,026	0.0	625.0	553.3	5,026
4	59.2	57.1	0.0	625.0	548.0	5,647	0.0	625.0	548.0	5,647
5	58.4	56.3	0.0	357.9	294.7	6,000	0.0	357.9	294.7	6,000
6	58.2	56.1	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
7	58.7	56.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	60.1	57.9	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	62.4	58.6	79.2	79.2	100.6	6,000	79.2	79.2	100.6	6,000
10	65.2	59.6	142.9	142.9	127.9	6,000	142.9	142.9	127.9	6,000
11	68.3	61.1	275.3	275.3	190.4	6,000	275.3	275.3	190.4	6,000
12	71.5	62.7	415.0	0.0	0.0	5,580	415.0	0.0	0.0	5,580
13	74.3	64.6	414.3	0.0	0.0	5,161	414.3	0.0	0.0	5,161
14	76.6	66.0	456.6	0.0	0.0	4,701	456.6	0.0	0.0	4,701
15	78.0	67.1	465.5	0.0	0.0	4,231	465.5	0.0	0.0	4,231
16	78.5	67.5	514.5	0.0	0.0	3,714	514.5	0.0	0.0	3,714
17	78.2	67.9	550.9	0.0	0.0	3,160	550.9	0.0	0.0	3,160
18	77.5	68.0	499.0	499.0	341.4	3,160	499.0	499.0	341.4	3,160
19	76.3	69.3	379.7	379.7	269.3	3,160	379.7	379.7	269.3	3,160
20	74.7	70.0	348.0	348.0	252.5	3,160	348.0	348.0	252.5	3,160
21	72.7	69.0	290.0	290.0	216.9	3,160	290.0	290.0	216.9	3,160
22	70.6	67.3	190.0	190.0	161.7	3,160	190.0	190.0	161.7	3,160
23	68.3	65.4	121.4	121.4	127.0	3,160	121.4	121.4	127.0	3,160
24	66.1	63.6	104.2	104.2	117.3	3,160	104.2	104.2	117.3	3,160

ECO IT-4

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

---- B U I L D I N G C O O L I N G D E M A N D S A N D T H E R M A L S T O R A G E ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	6,000
2	67.8	64.4	0.0	0.0	0.0	6,000
3	67.0	63.5	0.0	0.0	0.0	6,000
4	66.4	62.7	0.0	0.0	0.0	6,000
5	66.3	62.7	0.0	0.0	0.0	6,000
6	66.6	63.7	0.0	0.0	0.0	6,000
7	67.6	64.5	0.0	0.0	0.0	6,000
8	69.3	65.1	0.0	0.0	0.0	6,000
9	71.8	66.0	0.0	0.0	0.0	6,000
10	74.6	67.6	109.2	109.2	101.4	6,000
11	77.8	69.8	241.8	241.8	168.0	6,000
12	80.9	71.9	384.5	0.0	0.0	5,611
13	83.2	73.5	353.7	0.0	0.0	5,252
14	84.7	74.4	435.0	0.0	0.0	4,813
15	85.3	74.6	542.1	0.0	0.0	4,267
16	84.7	74.5	682.4	0.0	0.0	3,582
17	83.4	73.5	806.8	0.0	0.0	2,772
18	81.3	71.5	768.0	635.0	449.1	2,639
19	78.8	70.1	652.3	635.0	444.0	2,622
20	76.3	70.0	591.1	591.1	405.7	2,622
21	74.2	69.5	546.4	546.4	367.2	2,622
22	72.3	68.7	422.4	422.4	272.8	2,622
23	70.8	67.1	0.0	490.0	465.8	3,110
24	69.7	65.8	0.0	490.0	460.7	3,597

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	490.0	458.8	4,084	0.0	490.0	458.8	3,934
2	66.0	63.9	0.0	490.0	453.5	4,571	0.0	490.0	453.5	4,421
3	64.6	62.4	0.0	490.0	448.0	5,057	0.0	490.0	448.0	4,907
4	63.7	61.3	0.0	490.0	444.1	5,543	0.0	490.0	444.1	5,393
5	63.0	60.8	0.0	461.3	409.6	6,000	0.0	490.0	442.4	5,879
6	62.8	61.2	0.0	0.0	0.0	6,000	0.0	125.7	127.0	6,000
7	63.4	61.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	65.1	62.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	67.6	63.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	70.7	65.2	286.9	286.9	182.6	6,000	286.9	286.9	182.6	6,000
11	74.0	67.5	432.3	432.3	276.5	6,000	432.3	432.3	276.5	6,000
12	77.1	69.8	557.6	0.0	0.0	5,438	557.6	0.0	0.0	5,438
13	79.6	71.6	535.2	0.0	0.0	4,898	535.2	0.0	0.0	4,898

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	0.0	0.0	4,360	534.2	0.0	0.0	4,360
15	81.8	72.8	561.4	0.0	0.0	3,795	561.4	0.0	0.0	3,795
16	81.6	73.1	609.6	0.0	0.0	3,182	609.6	0.0	0.0	3,182
17	81.0	72.7	678.8	0.0	0.0	2,501	678.8	0.0	0.0	2,501
18	80.0	71.6	665.1	635.0	449.5	2,471	665.1	635.0	449.5	2,471
19	78.7	71.3	542.0	542.0	369.4	2,471	542.0	542.0	369.4	2,471
20	77.1	72.0	496.4	496.4	335.5	2,471	496.4	496.4	335.5	2,471
21	75.3	71.8	448.1	448.1	298.9	2,471	448.1	448.1	298.9	2,471
22	73.3	71.0	338.5	338.5	225.0	2,471	338.5	338.5	225.0	2,471
23	71.3	68.9	0.0	490.0	473.0	2,959	0.0	490.0	473.0	2,959
24	69.4	66.8	0.0	490.0	464.6	3,447	0.0	490.0	464.6	3,447

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	490.0	458.8	3,934	0.0	490.0	458.8	3,934
2	66.0	63.9	0.0	490.0	453.5	4,421	0.0	490.0	453.5	4,421
3	64.6	62.4	0.0	490.0	448.0	4,907	0.0	490.0	448.0	4,907
4	63.7	61.3	0.0	490.0	444.1	5,393	0.0	490.0	444.1	5,393
5	63.0	60.8	0.0	490.0	442.4	5,879	0.0	490.0	442.4	5,879
6	62.8	61.2	0.0	125.7	127.0	6,000	0.0	125.7	127.0	6,000
7	63.4	61.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	65.1	62.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	67.6	63.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	70.7	65.2	286.9	286.9	182.6	6,000	286.9	286.9	182.6	6,000
11	74.0	67.5	432.3	432.3	276.5	6,000	432.3	432.3	276.5	6,000
12	77.1	69.8	557.6	0.0	0.0	5,438	557.6	0.0	0.0	5,438
13	79.6	71.6	535.2	0.0	0.0	4,898	535.2	0.0	0.0	4,898
14	81.3	72.7	534.2	0.0	0.0	4,360	534.2	0.0	0.0	4,360
15	81.8	72.8	561.4	0.0	0.0	3,795	561.4	0.0	0.0	3,795
16	81.6	73.1	609.6	0.0	0.0	3,182	609.6	0.0	0.0	3,182
17	81.0	72.7	678.8	0.0	0.0	2,501	678.8	0.0	0.0	2,501
18	80.0	71.6	665.1	635.0	449.5	2,471	665.1	635.0	449.5	2,471
19	78.7	71.3	542.0	542.0	369.4	2,471	542.0	542.0	369.4	2,471
20	77.1	72.0	496.4	496.4	335.5	2,471	496.4	496.4	335.5	2,471
21	75.3	71.8	448.1	448.1	298.9	2,471	448.1	448.1	298.9	2,471
22	73.3	71.0	338.5	338.5	225.0	2,471	338.5	338.5	225.0	2,471
23	71.3	68.9	0.0	490.0	473.0	2,959	0.0	490.0	473.0	2,959
24	69.4	66.8	0.0	490.0	464.6	3,447	0.0	490.0	464.6	3,447

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	0.0	490.0	472.6	3,934
2	72.3	67.9	0.0	490.0	468.9	4,421
3	71.4	67.2	0.0	490.0	466.2	4,907
4	70.7	67.0	0.0	490.0	465.4	5,393
5	70.5	66.9	0.0	490.0	465.0	5,879
6	71.0	67.4	0.0	125.7	136.7	6,000
7	72.1	68.4	0.0	0.0	0.0	6,000
8	74.1	69.3	0.0	0.0	0.0	6,000
9	77.0	70.1	0.0	0.0	0.0	6,000
10	80.4	71.4	494.4	494.4	332.2	6,000
11	84.2	73.3	672.3	635.0	455.9	5,963
12	87.8	75.5	775.6	0.0	0.0	5,182
13	90.5	76.5	733.0	0.0	0.0	4,445
14	92.3	76.8	763.3	0.0	0.0	3,678
15	93.0	77.0	805.4	0.0	0.0	2,870
16	92.3	76.7	891.8	0.0	0.0	1,976
17	90.8	75.3	889.6	0.0	0.0	1,085
18	88.3	74.2	860.2	635.0	459.3	860
19	85.4	72.9	714.1	635.0	454.3	780
20	82.4	73.4	680.5	635.0	456.2	735
21	80.0	73.0	641.2	635.0	454.7	729
22	77.7	72.3	559.5	559.5	387.0	729
23	75.9	70.6	0.0	490.0	479.9	1,218
24	74.6	69.4	0.0	490.0	475.0	1,707

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	490.0	481.6	2,196	0.0	490.0	481.6	3,194
2	71.9	68.8	0.0	490.0	472.6	2,684	0.0	490.0	472.6	3,681
3	69.9	67.0	0.0	490.0	465.4	3,172	0.0	490.0	465.4	4,168
4	68.3	65.9	0.0	490.0	461.1	3,659	0.0	490.0	461.1	4,655
5	67.4	65.2	0.0	490.0	458.4	4,147	0.0	490.0	458.4	5,141
6	67.0	64.9	0.0	490.0	457.3	4,633	0.0	490.0	457.3	5,627
7	67.5	65.3	0.0	490.0	458.8	5,120	0.0	377.3	335.3	6,000
8	68.8	65.6	0.0	490.0	459.9	5,605	0.0	0.0	0.0	6,000
9	70.9	65.7	0.0	399.0	358.7	6,000	0.0	0.0	0.0	6,000
10	73.6	66.5	305.3	305.3	195.4	6,000	305.3	305.3	195.4	6,000
11	76.7	67.9	454.0	454.0	292.7	6,000	454.0	454.0	292.7	6,000
12	79.9	69.9	581.5	0.0	0.0	5,414	581.5	0.0	0.0	5,414
13	83.0	71.3	563.2	0.0	0.0	4,846	563.2	0.0	0.0	4,846

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	0.0	0.0	4,245	597.7	0.0	0.0	4,245
15	87.8	73.9	654.3	0.0	0.0	3,587	654.3	0.0	0.0	3,587
16	89.1	75.3	737.3	0.0	0.0	2,847	737.3	0.0	0.0	2,847
17	89.5	75.5	810.6	0.0	0.0	2,034	810.6	0.0	0.0	2,034
18	89.2	76.2	803.8	635.0	467.1	1,865	803.8	635.0	467.1	1,865
19	88.3	76.7	700.3	635.0	469.1	1,800	700.3	635.0	469.1	1,800
20	86.7	78.6	684.0	635.0	476.7	1,751	684.0	635.0	476.7	1,751
21	84.7	78.8	656.5	635.0	477.5	1,729	656.5	635.0	477.5	1,729
22	82.3	78.0	549.7	549.7	397.9	1,729	549.7	549.7	397.9	1,729
23	79.6	75.4	0.0	490.0	500.4	2,218	0.0	490.0	500.4	2,218
24	76.9	73.0	0.0	490.0	490.0	2,706	0.0	490.0	490.0	2,706

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	490.0	481.6	3,194	0.0	490.0	481.6	3,194
2	71.9	68.8	0.0	490.0	472.6	3,681	0.0	490.0	472.6	3,681
3	69.9	67.0	0.0	490.0	465.4	4,168	0.0	490.0	465.4	4,168
4	68.3	65.9	0.0	490.0	461.1	4,655	0.0	490.0	461.1	4,655
5	67.4	65.2	0.0	490.0	458.4	5,141	0.0	490.0	458.4	5,141
6	67.0	64.9	0.0	490.0	457.3	5,627	0.0	490.0	457.3	5,627
7	67.5	65.3	0.0	377.3	335.3	6,000	0.0	377.3	335.3	6,000
8	68.8	65.6	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	70.9	65.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	73.6	66.5	305.3	305.3	195.4	6,000	305.3	305.3	195.4	6,000
11	76.7	67.9	454.0	454.0	292.7	6,000	454.0	454.0	292.7	6,000
12	79.9	69.9	581.5	0.0	0.0	5,414	581.5	0.0	0.0	5,414
13	83.0	71.3	563.2	0.0	0.0	4,846	563.2	0.0	0.0	4,846
14	85.7	72.5	597.7	0.0	0.0	4,245	597.7	0.0	0.0	4,245
15	87.8	73.9	654.3	0.0	0.0	3,587	654.3	0.0	0.0	3,587
16	89.1	75.3	737.3	0.0	0.0	2,847	737.3	0.0	0.0	2,847
17	89.5	75.5	810.6	0.0	0.0	2,034	810.6	0.0	0.0	2,034
18	89.2	76.2	803.8	635.0	467.1	1,865	803.8	635.0	467.1	1,865
19	88.3	76.7	700.3	635.0	469.1	1,800	700.3	635.0	469.1	1,800
20	86.7	78.6	684.0	635.0	476.7	1,751	684.0	635.0	476.7	1,751
21	84.7	78.8	656.5	635.0	477.5	1,729	656.5	635.0	477.5	1,729
22	82.3	78.0	549.7	549.7	397.9	1,729	549.7	549.7	397.9	1,729
23	79.6	75.4	0.0	490.0	500.4	2,218	0.0	490.0	500.4	2,218
24	76.9	73.0	0.0	490.0	490.0	2,706	0.0	490.0	490.0	2,706

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	0.0	490.0	455.7	3,194
2	69.5	63.5	0.0	490.0	452.0	3,681
3	68.7	63.0	0.0	490.0	450.2	4,168
4	68.1	62.4	0.0	490.0	448.0	4,655
5	67.9	62.6	0.0	490.0	448.7	5,141
6	68.3	63.2	0.0	490.0	450.9	5,627
7	69.3	64.1	0.0	377.3	331.6	6,000
8	71.1	64.9	0.0	0.0	0.0	6,000
9	73.7	66.1	0.0	0.0	0.0	6,000
10	76.8	67.2	406.9	406.9	258.7	6,000
11	80.2	68.9	583.6	583.6	395.7	6,000
12	83.4	70.6	695.3	0.0	0.0	5,300
13	85.8	71.5	664.3	0.0	0.0	4,631
14	87.5	72.5	698.6	0.0	0.0	3,929
15	88.1	72.7	727.3	0.0	0.0	3,199
16	87.5	71.7	794.2	0.0	0.0	2,402
17	86.0	70.6	806.4	0.0	0.0	1,593
18	83.8	69.7	758.7	635.0	442.5	1,470
19	81.2	68.5	598.2	598.2	406.7	1,470
20	78.6	68.7	545.2	545.2	363.8	1,470
21	76.4	68.8	454.4	454.4	295.4	1,470
22	74.3	67.6	321.1	321.1	206.7	1,470
23	72.7	66.4	0.0	490.0	463.0	1,959
24	71.5	65.3	0.0	490.0	458.8	2,447

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	490.0	458.8	2,935	0.0	490.0	458.8	4,066
2	68.2	63.5	0.0	490.0	452.0	3,423	0.0	490.0	452.0	4,553
3	66.6	62.2	0.0	490.0	447.3	3,910	0.0	490.0	447.3	5,039
4	65.4	61.1	0.0	490.0	443.4	4,397	0.0	490.0	443.4	5,525
5	64.6	60.7	0.0	490.0	442.0	4,883	0.0	479.3	429.7	6,000
6	64.4	60.7	0.0	490.0	442.0	5,369	0.0	0.0	0.0	6,000
7	64.9	61.2	0.0	490.0	443.8	5,855	0.0	0.0	0.0	6,000
8	66.3	61.6	0.0	149.6	142.6	6,000	0.0	0.0	0.0	6,000
9	68.5	62.5	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	71.4	63.6	250.5	250.5	160.7	6,000	250.6	250.6	160.7	6,000
11	74.5	65.1	396.0	396.0	246.6	6,000	396.0	396.0	246.6	6,000
12	77.6	66.8	504.8	0.0	0.0	5,490	504.8	0.0	0.0	5,490
13	80.5	68.2	495.1	0.0	0.0	4,991	495.1	0.0	0.0	4,991

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	0.0	0.0	4,461	525.9	0.0	0.0	4,461
15	84.2	70.7	562.3	0.0	0.0	3,895	562.3	0.0	0.0	3,895
16	84.6	70.5	612.6	0.0	0.0	3,279	612.6	0.0	0.0	3,279
17	84.4	70.4	668.2	0.0	0.0	2,609	668.2	0.0	0.0	2,609
18	83.6	70.7	640.3	635.0	446.2	2,603	640.3	635.0	446.2	2,603
19	82.4	70.7	496.1	496.1	331.5	2,603	496.1	496.1	331.5	2,603
20	80.8	71.9	476.3	476.3	319.9	2,603	476.3	476.3	319.9	2,603
21	78.9	72.4	433.7	433.7	290.2	2,603	433.7	433.7	290.2	2,603
22	76.8	71.1	330.5	330.5	220.5	2,603	330.5	330.5	220.5	2,603
23	74.5	69.3	0.0	490.0	474.6	3,091	0.0	490.0	474.6	3,091
24	72.2	67.2	0.0	490.0	466.2	3,579	0.0	490.0	466.2	3,579

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	490.0	458.8	4,066	0.0	490.0	458.8	4,066
2	68.2	63.5	0.0	490.0	452.0	4,553	0.0	490.0	452.0	4,553
3	66.6	62.2	0.0	490.0	447.3	5,039	0.0	490.0	447.3	5,039
4	65.4	61.1	0.0	490.0	443.4	5,525	0.0	490.0	443.4	5,525
5	64.6	60.7	0.0	479.4	429.7	6,000	0.0	479.4	429.7	6,000
6	64.4	60.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
7	64.9	61.2	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	66.3	61.6	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	68.5	62.5	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	71.4	63.6	250.6	250.6	160.7	6,000	250.6	250.6	160.7	6,000
11	74.5	65.1	396.0	396.0	246.6	6,000	396.0	396.0	246.6	6,000
12	77.6	66.8	504.8	0.0	0.0	5,490	504.8	0.0	0.0	5,490
13	80.5	68.2	495.1	0.0	0.0	4,991	495.1	0.0	0.0	4,991
14	82.7	69.7	525.9	0.0	0.0	4,461	525.9	0.0	0.0	4,461
15	84.2	70.7	562.3	0.0	0.0	3,895	562.3	0.0	0.0	3,895
16	84.6	70.5	612.6	0.0	0.0	3,279	612.6	0.0	0.0	3,279
17	84.4	70.4	668.2	0.0	0.0	2,609	668.2	0.0	0.0	2,609
18	83.6	70.7	640.3	635.0	446.2	2,603	640.3	635.0	446.2	2,603
19	82.4	70.7	496.1	496.1	331.5	2,603	496.1	496.1	331.5	2,603
20	80.8	71.9	476.3	476.3	319.9	2,603	476.3	476.3	319.9	2,603
21	78.9	72.4	433.7	433.7	290.2	2,603	433.7	433.7	290.2	2,603
22	76.8	71.1	330.5	330.5	220.5	2,603	330.5	330.5	220.5	2,603
23	74.5	69.3	0.0	490.0	474.6	3,091	0.0	490.0	474.6	3,091
24	72.2	67.2	0.0	490.0	466.2	3,579	0.0	490.0	466.2	3,579

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	0.0	490.0	442.0	4,066
2	63.3	59.8	0.0	490.0	439.0	4,553
3	62.4	59.2	0.0	490.0	437.0	5,039
4	61.8	58.5	0.0	490.0	434.7	5,525
5	61.6	58.3	0.0	479.4	421.9	6,000
6	62.0	58.7	0.0	0.0	0.0	6,000
7	63.1	59.8	0.0	0.0	0.0	6,000
8	64.9	61.3	0.0	0.0	0.0	6,000
9	67.5	62.3	0.0	0.0	0.0	6,000
10	70.6	63.4	305.6	305.6	189.1	6,000
11	74.0	65.1	491.7	491.7	312.5	6,000
12	77.3	66.6	611.3	0.0	0.0	5,384
13	79.7	68.1	579.7	0.0	0.0	4,800
14	81.3	68.9	596.3	0.0	0.0	4,200
15	81.9	69.3	623.8	0.0	0.0	3,573
16	81.3	68.8	684.1	0.0	0.0	2,886
17	79.9	68.2	694.6	0.0	0.0	2,189
18	77.7	67.0	653.5	635.0	433.1	2,170
19	75.0	66.9	506.2	506.2	328.2	2,170
20	72.4	66.6	369.5	369.5	233.3	2,170
21	70.2	65.3	283.2	283.2	180.9	2,170
22	68.1	63.7	169.8	169.8	122.8	2,170
23	66.5	62.5	0.0	490.0	448.4	2,658
24	65.3	61.6	0.0	490.0	445.2	3,146

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	490.0	444.8	3,634	0.0	490.0	444.8	4,621
2	62.0	59.7	0.0	490.0	438.6	4,121	0.0	490.0	438.6	5,108
3	60.4	58.4	0.0	490.0	434.4	4,608	0.0	490.0	434.4	5,594
4	59.2	57.1	0.0	490.0	430.3	5,094	0.0	411.0	344.7	6,000
5	58.4	56.3	0.0	490.0	427.9	5,580	0.0	0.0	0.0	6,000
6	58.2	56.1	0.0	424.6	356.0	6,000	0.0	0.0	0.0	6,000
7	58.7	56.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	60.1	57.9	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	62.4	58.6	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	65.2	59.6	142.2	142.2	105.9	6,000	142.9	142.9	106.1	6,000
11	68.3	61.1	275.3	275.3	168.6	6,000	275.3	275.3	168.6	6,000
12	71.5	62.7	415.0	0.0	0.0	5,580	415.0	0.0	0.0	5,580
13	74.3	64.6	413.9	0.0	0.0	5,162	414.3	0.0	0.0	5,161

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	0.0	0.0	4,701	456.6	0.0	0.0	4,701
15	78.0	67.1	465.5	0.0	0.0	4,232	465.5	0.0	0.0	4,231
16	78.5	67.5	514.5	0.0	0.0	3,714	514.5	0.0	0.0	3,714
17	78.2	67.9	550.9	0.0	0.0	3,160	550.9	0.0	0.0	3,160
18	77.5	68.0	499.0	499.0	325.9	3,160	499.0	499.0	325.9	3,160
19	76.3	69.3	379.7	379.7	245.9	3,160	379.7	379.7	245.9	3,160
20	74.7	70.0	348.0	348.0	228.3	3,160	348.0	348.0	228.3	3,160
21	72.7	69.0	290.0	290.0	192.4	3,160	290.0	290.0	192.4	3,160
22	70.6	67.3	190.0	190.0	137.7	3,160	190.0	190.0	137.7	3,160
23	68.3	65.4	0.0	490.0	459.2	3,648	0.0	490.0	459.2	3,647
24	66.1	63.6	0.0	490.0	452.4	4,135	0.0	490.0	452.4	4,134

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	490.0	444.8	4,621	0.0	490.0	444.8	4,621
2	62.0	59.7	0.0	490.0	438.6	5,107	0.0	490.0	438.6	5,107
3	60.4	58.4	0.0	490.0	434.4	5,593	0.0	490.0	434.4	5,593
4	59.2	57.1	0.0	411.3	345.1	6,000	0.0	411.3	345.1	6,000
5	58.4	56.3	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
6	58.2	56.1	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
7	58.7	56.7	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
8	60.1	57.9	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
9	62.4	58.6	0.0	0.0	0.0	6,000	0.0	0.0	0.0	6,000
10	65.2	59.6	142.9	142.9	106.1	6,000	142.9	142.9	106.1	6,000
11	68.3	61.1	275.3	275.3	168.6	6,000	275.3	275.3	168.6	6,000
12	71.5	62.7	415.0	0.0	0.0	5,580	415.0	0.0	0.0	5,580
13	74.3	64.6	414.3	0.0	0.0	5,161	414.3	0.0	0.0	5,161
14	76.6	66.0	456.6	0.0	0.0	4,701	456.6	0.0	0.0	4,701
15	78.0	67.1	465.5	0.0	0.0	4,231	465.5	0.0	0.0	4,231
16	78.5	67.5	514.5	0.0	0.0	3,714	514.5	0.0	0.0	3,714
17	78.2	67.9	550.9	0.0	0.0	3,160	550.9	0.0	0.0	3,160
18	77.5	68.0	499.0	499.0	325.9	3,160	499.0	499.0	325.9	3,160
19	76.3	69.3	379.7	379.7	245.9	3,160	379.7	379.7	245.9	3,160
20	74.7	70.0	348.0	348.0	228.3	3,160	348.0	348.0	228.3	3,160
21	72.7	69.0	290.0	290.0	192.4	3,160	290.0	290.0	192.4	3,160
22	70.6	67.3	190.0	190.0	137.7	3,160	190.0	190.0	137.7	3,160
23	68.3	65.4	0.0	490.0	459.2	3,647	0.0	490.0	459.2	3,647
24	66.1	63.6	0.0	490.0	452.4	4,134	0.0	490.0	452.4	4,134

ECO IT-5

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

June

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	68.7	65.1	0.0	0.0	0.0	4,500
2	67.8	64.4	0.0	0.0	0.0	4,500
3	67.0	63.5	0.0	0.0	0.0	4,500
4	66.4	62.7	0.0	0.0	0.0	4,500
5	66.3	62.7	0.0	0.0	0.0	4,500
6	66.6	63.7	0.0	0.0	0.0	4,500
7	67.6	64.5	0.0	0.0	0.0	4,500
8	69.3	65.1	0.0	0.0	0.0	4,500
9	71.8	66.0	0.0	0.0	0.0	4,500
10	74.6	67.6	109.2	109.2	98.1	4,500
11	77.8	69.8	241.8	241.8	172.7	4,500
12	80.9	71.9	384.5	384.5	275.8	4,500
13	83.2	73.5	353.7	0.0	0.0	4,143
14	84.7	74.4	435.0	0.0	0.0	3,704
15	85.3	74.6	542.1	0.0	0.0	3,159
16	84.7	74.5	682.4	520.0	403.3	2,997
17	83.4	73.5	806.8	520.0	399.9	2,710
18	81.3	71.5	768.0	520.0	393.3	2,462
19	78.8	70.1	652.3	520.0	388.9	2,330
20	76.3	70.0	591.1	520.0	388.5	2,259
21	74.2	69.5	546.4	520.0	387.0	2,232
22	72.3	68.7	422.4	422.4	298.4	2,232
23	70.8	67.1	0.0	400.0	379.7	2,631
24	69.7	65.8	0.0	400.0	375.6	3,028

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	400.0	374.0	3,426	0.0	400.0	374.0	3,600
2	66.0	63.9	0.0	400.0	369.6	3,823	0.0	400.0	369.6	3,997
3	64.6	62.4	0.0	400.0	365.1	4,220	0.0	400.0	365.1	4,394
4	63.7	61.3	0.0	283.1	239.9	4,500	0.0	109.6	108.1	4,500
5	63.0	60.8	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
6	62.8	61.2	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
7	63.4	61.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
8	65.1	62.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	67.6	63.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	70.7	65.2	286.9	286.9	191.3	4,500	286.9	286.9	191.4	4,500
11	74.0	67.5	432.3	432.3	303.5	4,500	432.3	432.3	303.5	4,500
12	77.1	69.8	557.6	520.0	387.9	4,462	557.6	520.0	387.9	4,462
13	79.6	71.6	535.2	0.0	0.0	3,924	535.2	0.0	0.0	3,924

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	81.3	72.7	534.2	0.0	0.0	3,386	534.2	0.0	0.0	3,386
15	81.8	72.8	561.4	0.0	0.0	2,822	561.4	0.0	0.0	2,822
16	81.6	73.1	609.6	520.0	398.6	2,733	609.6	520.0	398.6	2,733
17	81.0	72.7	678.8	520.0	397.3	2,574	678.8	520.0	397.3	2,574
18	80.0	71.6	665.1	520.0	393.7	2,429	665.1	520.0	393.7	2,429
19	78.7	71.3	542.0	520.0	392.7	2,407	542.0	520.0	392.7	2,407
20	77.1	72.0	496.4	496.4	372.7	2,407	496.4	496.4	372.7	2,407
21	75.3	71.8	448.1	448.1	328.5	2,407	448.1	448.1	328.5	2,407
22	73.3	71.0	338.5	338.5	238.5	2,407	338.5	338.5	238.5	2,407
23	71.3	68.9	0.0	400.0	385.6	2,805	0.0	400.0	385.6	2,805
24	69.4	66.8	0.0	400.0	378.8	3,203	0.0	400.0	378.8	3,203

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	67.6	65.3	0.0	400.0	374.0	3,600	0.0	400.0	374.0	3,600
2	66.0	63.9	0.0	400.0	369.6	3,997	0.0	400.0	369.6	3,997
3	64.6	62.4	0.0	400.0	365.1	4,394	0.0	400.0	365.1	4,394
4	63.7	61.3	0.0	109.6	108.1	4,500	0.0	109.6	108.1	4,500
5	63.0	60.8	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
6	62.8	61.2	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
7	63.4	61.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
8	65.1	62.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	67.6	63.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	70.7	65.2	286.9	286.9	191.4	4,500	286.9	286.9	191.4	4,500
11	74.0	67.5	432.3	432.3	303.5	4,500	432.3	432.3	303.5	4,500
12	77.1	69.8	557.6	520.0	387.9	4,462	557.6	520.0	387.9	4,462
13	79.6	71.6	535.2	0.0	0.0	3,924	535.2	0.0	0.0	3,924
14	81.3	72.7	534.2	0.0	0.0	3,386	534.2	0.0	0.0	3,386
15	81.8	72.8	561.4	0.0	0.0	2,822	561.4	0.0	0.0	2,822
16	81.6	73.1	609.6	520.0	398.6	2,733	609.6	520.0	398.6	2,733
17	81.0	72.7	678.8	520.0	397.3	2,574	678.8	520.0	397.3	2,574
18	80.0	71.6	665.1	520.0	393.7	2,429	665.1	520.0	393.7	2,429
19	78.7	71.3	542.0	520.0	392.7	2,407	542.0	520.0	392.7	2,407
20	77.1	72.0	496.4	496.4	372.7	2,407	496.4	496.4	372.7	2,407
21	75.3	71.8	448.1	448.1	328.5	2,407	448.1	448.1	328.5	2,407
22	73.3	71.0	338.5	338.5	238.5	2,407	338.5	338.5	238.5	2,407
23	71.3	68.9	0.0	400.0	385.6	2,805	0.0	400.0	385.6	2,805
24	69.4	66.8	0.0	400.0	378.8	3,203	0.0	400.0	378.8	3,203

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

July

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	73.4	68.8	0.0	400.0	385.3	3,600
2	72.3	67.9	0.0	400.0	382.3	3,997
3	71.4	67.2	0.0	400.0	380.0	4,394
4	70.7	67.0	0.0	109.6	115.7	4,500
5	70.5	66.9	0.0	0.0	0.0	4,500
6	71.0	67.4	0.0	0.0	0.0	4,500
7	72.1	68.4	0.0	0.0	0.0	4,500
8	74.1	69.3	0.0	0.0	0.0	4,500
9	77.0	70.1	0.0	0.0	0.0	4,500
10	80.4	71.4	494.4	494.4	369.0	4,500
11	84.2	73.3	672.3	520.0	399.3	4,348
12	87.8	75.5	775.6	520.0	406.7	4,092
13	90.5	76.5	733.0	0.0	0.0	3,356
14	92.3	76.8	763.3	0.0	0.0	2,590
15	93.0	77.0	805.4	0.0	0.0	1,782
16	92.3	76.7	891.8	520.0	410.8	1,411
17	90.8	75.3	889.6	520.0	406.0	1,041
18	88.3	74.2	860.2	520.0	402.3	701
19	85.4	72.9	714.1	520.0	397.9	507
20	82.4	73.4	680.5	520.0	399.6	346
21	80.0	73.0	641.2	520.0	398.3	225
22	77.7	72.3	559.5	520.0	395.9	186
23	75.9	70.6	0.0	400.0	391.3	585
24	74.6	69.4	0.0	400.0	387.3	985

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	400.0	392.7	1,384	0.0	400.0	392.7	2,508
2	71.9	68.8	0.0	400.0	385.3	1,783	0.0	400.0	385.3	2,906
3	69.9	67.0	0.0	400.0	379.4	2,182	0.0	400.0	379.4	3,303
4	68.3	65.9	0.0	400.0	375.9	2,580	0.0	400.0	375.9	3,701
5	67.4	65.2	0.0	400.0	373.7	2,978	0.0	400.0	373.7	4,098
6	67.0	64.9	0.0	400.0	372.7	3,375	0.0	400.0	372.7	4,494
7	67.5	65.3	0.0	400.0	374.0	3,773	0.0	0.0	0.0	4,500
8	68.8	65.6	0.0	400.0	374.9	4,170	0.0	0.0	0.0	4,500
9	70.9	65.7	0.0	333.6	300.7	4,500	0.0	0.0	0.0	4,500
10	73.6	66.5	305.3	305.3	205.9	4,500	305.3	305.3	205.9	4,500
11	76.7	67.9	454.0	454.0	322.9	4,500	454.0	454.0	322.9	4,500
12	79.9	69.9	581.5	520.0	388.2	4,438	581.5	520.0	388.2	4,438
13	83.0	71.3	563.2	0.0	0.0	3,872	563.2	0.0	0.0	3,872

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	85.7	72.5	597.7	0.0	0.0	3,271	597.7	0.0	0.0	3,271
15	87.8	73.9	654.3	0.0	0.0	2,614	654.3	0.0	0.0	2,614
16	89.1	75.3	737.3	520.0	406.0	2,397	737.3	520.0	406.0	2,397
17	89.5	75.5	810.6	520.0	406.7	2,106	810.6	520.0	406.7	2,106
18	89.2	76.2	803.8	520.0	409.1	1,822	803.8	520.0	409.1	1,822
19	88.3	76.7	700.3	520.0	410.8	1,642	700.3	520.0	410.8	1,642
20	86.7	78.6	684.0	520.0	417.5	1,478	684.0	520.0	417.5	1,478
21	84.7	78.8	656.5	520.0	418.2	1,341	656.5	520.0	418.2	1,341
22	82.3	78.0	549.7	520.0	415.4	1,312	549.7	520.0	415.4	1,312
23	79.6	75.4	0.0	400.0	408.1	1,711	0.0	400.0	408.1	1,711
24	76.9	73.0	0.0	400.0	399.6	2,109	0.0	400.0	399.6	2,109

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	74.3	71.0	0.0	400.0	392.7	2,508	0.0	400.0	392.7	2,508
2	71.9	68.8	0.0	400.0	385.3	2,906	0.0	400.0	385.3	2,906
3	69.9	67.0	0.0	400.0	379.4	3,303	0.0	400.0	379.4	3,303
4	68.3	65.9	0.0	400.0	375.9	3,701	0.0	400.0	375.9	3,701
5	67.4	65.2	0.0	400.0	373.7	4,098	0.0	400.0	373.7	4,098
6	67.0	64.9	0.0	400.0	372.7	4,494	0.0	400.0	372.7	4,494
7	67.5	65.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
8	68.8	65.6	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	70.9	65.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	73.6	66.5	305.3	305.3	205.9	4,500	305.3	305.3	205.9	4,500
11	76.7	67.9	454.0	454.0	322.9	4,500	454.0	454.0	322.9	4,500
12	79.9	69.9	581.5	520.0	388.2	4,438	581.5	520.0	388.2	4,438
13	83.0	71.3	563.2	0.0	0.0	3,872	563.2	0.0	0.0	3,872
14	85.7	72.5	597.7	0.0	0.0	3,271	597.7	0.0	0.0	3,271
15	87.8	73.9	654.3	0.0	0.0	2,614	654.3	0.0	0.0	2,614
16	89.1	75.3	737.3	520.0	406.0	2,397	737.3	520.0	406.0	2,397
17	89.5	75.5	810.6	520.0	406.7	2,106	810.6	520.0	406.7	2,106
18	89.2	76.2	803.8	520.0	409.1	1,822	803.8	520.0	409.1	1,822
19	88.3	76.7	700.3	520.0	410.8	1,642	700.3	520.0	410.8	1,642
20	86.7	78.6	684.0	520.0	417.5	1,478	684.0	520.0	417.5	1,478
21	84.7	78.8	656.5	520.0	418.2	1,341	656.5	520.0	418.2	1,341
22	82.3	78.0	549.7	520.0	415.4	1,312	549.7	520.0	415.4	1,312
23	79.6	75.4	0.0	400.0	408.1	1,711	0.0	400.0	408.1	1,711
24	76.9	73.0	0.0	400.0	399.6	2,109	0.0	400.0	399.6	2,109

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- BUILDING COOLING DEMANDS AND THERMAL STORAGE ----

August

Hour	Design DADB (F)	Design DAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	70.5	64.5	0.0	400.0	371.5	2,508
2	69.5	63.5	0.0	400.0	368.4	2,906
3	68.7	63.0	0.0	400.0	366.9	3,303
4	68.1	62.4	0.0	400.0	365.1	3,701
5	67.9	62.6	0.0	400.0	365.7	4,098
6	68.3	63.2	0.0	400.0	367.5	4,494
7	69.3	64.1	0.0	0.0	0.0	4,500
8	71.1	64.9	0.0	0.0	0.0	4,500
9	73.7	66.1	0.0	0.0	0.0	4,500
10	76.8	67.2	406.9	406.9	282.1	4,500
11	80.2	68.9	583.6	520.0	385.1	4,436
12	83.4	70.6	695.3	520.0	390.4	4,261
13	85.8	71.5	664.3	0.0	0.0	3,593
14	87.5	72.5	698.6	0.0	0.0	2,892
15	88.1	72.7	727.3	0.0	0.0	2,162
16	87.5	71.7	794.2	520.0	394.0	1,888
17	86.0	70.6	806.4	520.0	390.4	1,602
18	83.8	69.7	758.7	520.0	387.6	1,363
19	81.2	68.5	598.2	520.0	383.9	1,285
20	78.6	68.7	545.2	520.0	384.5	1,259
21	76.4	68.8	454.4	454.4	325.7	1,259
22	74.3	67.6	321.1	321.1	218.8	1,259
23	72.7	66.4	0.0	400.0	377.5	1,658
24	71.5	65.3	0.0	400.0	374.0	2,057

Hour	Typical DADB (F)	Typical DAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	400.0	374.0	2,455	0.0	400.0	374.0	3,739
2	68.2	63.5	0.0	400.0	368.4	2,854	0.0	400.0	368.4	4,136
3	66.6	62.2	0.0	400.0	364.6	3,251	0.0	367.3	327.4	4,500
4	65.4	61.1	0.0	400.0	361.4	3,649	0.0	0.0	0.0	4,500
5	64.6	60.7	0.0	400.0	360.2	4,046	0.0	0.0	0.0	4,500
6	64.4	60.7	0.0	400.0	360.2	4,442	0.0	0.0	0.0	4,500
7	64.9	61.2	0.0	61.1	79.9	4,500	0.0	0.0	0.0	4,500
8	66.3	61.6	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	68.5	62.5	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	71.4	63.6	250.5	250.5	166.1	4,500	250.6	250.6	166.1	4,500
11	74.5	65.1	396.0	396.0	268.5	4,500	396.0	396.0	268.5	4,500
12	77.6	66.8	504.8	504.8	364.7	4,500	504.8	504.8	364.7	4,500
13	80.5	68.2	495.1	0.0	0.0	4,001	495.1	0.0	0.0	4,001

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	82.7	69.7	525.9	0.0	0.0	3,472	525.9	0.0	0.0	3,472
15	84.2	70.7	562.3	0.0	0.0	2,907	562.3	0.0	0.0	2,907
16	84.6	70.5	612.6	520.0	390.1	2,815	612.6	520.0	390.1	2,815
17	84.4	70.4	668.2	520.0	389.8	2,666	668.2	520.0	389.8	2,666
18	83.6	70.7	640.3	520.0	390.8	2,546	640.3	520.0	390.8	2,546
19	82.4	70.7	496.1	496.1	368.4	2,546	496.1	496.1	368.4	2,546
20	80.8	71.9	476.3	476.3	353.9	2,546	476.3	476.3	353.9	2,546
21	78.9	72.4	433.7	433.7	317.8	2,546	433.7	433.7	317.8	2,546
22	76.8	71.1	330.5	330.5	232.9	2,546	330.5	330.5	232.9	2,546
23	74.5	69.3	0.0	400.0	387.0	2,944	0.0	400.0	387.0	2,944
24	72.2	67.2	0.0	400.0	380.0	3,342	0.0	400.0	380.0	3,342

	Typical		Sunday				Monday			
Hour	OADB (F)	OAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	70.1	65.3	0.0	400.0	374.0	3,739	0.0	400.0	374.0	3,739
2	68.2	63.5	0.0	400.0	368.4	4,136	0.0	400.0	368.4	4,136
3	66.6	62.2	0.0	367.3	327.4	4,500	0.0	367.3	327.4	4,500
4	65.4	61.1	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
5	64.6	60.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
6	64.4	60.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
7	64.9	61.2	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
8	66.3	61.6	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	68.5	62.5	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	71.4	63.6	250.6	250.6	166.1	4,500	250.6	250.6	166.1	4,500
11	74.5	65.1	396.0	396.0	268.5	4,500	396.0	396.0	268.5	4,500
12	77.6	66.8	504.8	504.8	364.7	4,500	504.8	504.8	364.7	4,500
13	80.5	68.2	495.1	0.0	0.0	4,001	495.1	0.0	0.0	4,001
14	82.7	69.7	525.9	0.0	0.0	3,472	525.9	0.0	0.0	3,472
15	84.2	70.7	562.3	0.0	0.0	2,907	562.3	0.0	0.0	2,907
16	84.6	70.5	612.6	520.0	390.1	2,815	612.6	520.0	390.1	2,815
17	84.4	70.4	668.2	520.0	389.8	2,666	668.2	520.0	389.8	2,666
18	83.6	70.7	640.3	520.0	390.8	2,546	640.3	520.0	390.8	2,546
19	82.4	70.7	496.1	496.1	368.4	2,546	496.1	496.1	368.4	2,546
20	80.8	71.9	476.3	476.3	353.9	2,546	476.3	476.3	353.9	2,546
21	78.9	72.4	433.7	433.7	317.8	2,546	433.7	433.7	317.8	2,546
22	76.8	71.1	330.5	330.5	232.9	2,546	330.5	330.5	232.9	2,546
23	74.5	69.3	0.0	400.0	387.0	2,944	0.0	400.0	387.0	2,944
24	72.2	67.2	0.0	400.0	380.0	3,342	0.0	400.0	380.0	3,342

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---- B U I L D I N G   C O O L I N G   D E M A N D S   A N D   T H E R M A L   S T O R A G E ----

September

Hour	Design OADB (F)	Design OAWB (F)	Design Cooling Load (Ton)	Design Chiller Load (Ton)	Design Chiller Demand (kW)	Design Storage Capacity (Ton-Hr)
1	64.3	60.7	0.0	400.0	360.2	3,739
2	63.3	59.8	0.0	400.0	357.7	4,136
3	62.4	59.2	0.0	367.3	319.4	4,500
4	61.8	58.5	0.0	0.0	0.0	4,500
5	61.6	58.3	0.0	0.0	0.0	4,500
6	62.0	58.7	0.0	0.0	0.0	4,500
7	63.1	59.8	0.0	0.0	0.0	4,500
8	64.9	61.3	0.0	0.0	0.0	4,500
9	67.5	62.3	0.0	0.0	0.0	4,500
10	70.6	63.4	305.6	305.6	200.2	4,500
11	74.0	65.1	491.7	491.7	348.2	4,500
12	77.3	66.6	611.3	520.0	378.1	4,409
13	79.7	68.1	579.7	0.0	0.0	3,825
14	81.3	68.9	596.3	0.0	0.0	3,226
15	81.9	69.3	623.8	0.0	0.0	2,600
16	81.3	68.8	684.1	520.0	384.8	2,436
17	79.9	68.2	694.6	520.0	382.9	2,261
18	77.7	67.0	653.5	520.0	379.3	2,128
19	75.0	66.9	506.2	506.2	366.3	2,128
20	72.4	66.6	369.5	369.5	251.7	2,128
21	70.2	65.3	283.2	283.2	189.2	2,128
22	68.1	63.7	169.8	169.8	122.6	2,128
23	66.5	62.5	0.0	400.0	365.4	2,526
24	65.3	61.6	0.0	400.0	362.8	2,924

Hour	Typical OADB (F)	Typical OAWB (F)	Weekday Cooling Load (Ton)	Weekday Chiller Load (Ton)	Weekday Chiller Demand (kW)	Weekday Storage Capacity (Ton-Hr)	Saturday Cooling Load (Ton)	Saturday Chiller Load (Ton)	Saturday Chiller Demand (kW)	Saturday Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	400.0	362.5	3,321	0.0	400.0	362.5	4,315
2	62.0	59.7	0.0	400.0	357.4	3,719	0.0	188.6	158.6	4,500
3	60.4	58.4	0.0	400.0	353.9	4,116	0.0	0.0	0.0	4,500
4	59.2	57.1	0.0	387.5	336.4	4,500	0.0	0.0	0.0	4,500
5	58.4	56.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
6	58.2	56.1	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
7	58.7	56.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
8	60.1	57.9	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	62.4	58.6	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	65.2	59.6	142.2	142.2	104.3	4,500	142.9	142.9	104.6	4,500
11	68.3	61.1	275.3	275.3	176.8	4,500	275.3	275.3	176.8	4,500
12	71.5	62.7	415.0	415.0	277.8	4,500	415.0	415.0	277.8	4,500
13	74.3	64.6	413.9	0.0	0.0	4,082	414.3	0.0	0.0	4,082

COLD THERMAL STORAGE - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

	Typical		Weekday				Saturday			
Hour	DADB (F)	DAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
14	76.6	66.0	456.6	0.0	0.0	3,623	456.6	0.0	0.0	3,622
15	78.0	67.1	465.5	0.0	0.0	3,154	465.5	0.0	0.0	3,154
16	78.5	67.5	514.5	514.5	375.7	3,154	514.5	514.5	375.7	3,154
17	78.2	67.9	550.9	520.0	382.0	3,123	550.9	520.0	382.0	3,123
18	77.5	68.0	499.0	499.0	362.9	3,123	499.0	499.0	362.9	3,123
19	76.3	69.3	379.7	379.7	265.8	3,123	379.7	379.7	265.8	3,123
20	74.7	70.0	348.0	348.0	243.3	3,123	348.0	348.0	243.3	3,123
21	72.7	69.0	290.0	290.0	200.9	3,123	290.0	290.0	200.9	3,123
22	70.6	67.3	190.0	190.0	138.7	3,123	190.0	190.0	138.7	3,123
23	68.3	65.4	0.0	400.0	374.3	3,521	0.0	400.0	374.3	3,521
24	66.1	63.6	0.0	400.0	368.7	3,918	0.0	400.0	368.7	3,918

	Typical		Sunday				Monday			
Hour	DADB (F)	DAWB (F)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)	Cooling Load (Ton)	Chiller Load (Ton)	Chiller Demand (kW)	Storage Capacity (Ton-Hr)
1	63.9	61.5	0.0	400.0	362.5	4,315	0.0	400.0	362.5	4,315
2	62.0	59.7	0.0	188.9	158.8	4,500	0.0	188.9	158.8	4,500
3	60.4	58.4	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
4	59.2	57.1	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
5	58.4	56.3	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
6	58.2	56.1	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
7	58.7	56.7	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
8	60.1	57.9	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
9	62.4	58.6	0.0	0.0	0.0	4,500	0.0	0.0	0.0	4,500
10	65.2	59.6	142.9	142.9	104.6	4,500	142.9	142.9	104.6	4,500
11	68.3	61.1	275.3	275.3	176.8	4,500	275.3	275.3	176.8	4,500
12	71.5	62.7	415.0	415.0	277.8	4,500	415.0	415.0	277.8	4,500
13	74.3	64.6	414.3	0.0	0.0	4,082	414.3	0.0	0.0	4,082
14	76.6	66.0	456.6	0.0	0.0	3,622	456.6	0.0	0.0	3,622
15	78.0	67.1	465.5	0.0	0.0	3,154	465.5	0.0	0.0	3,154
16	78.5	67.5	514.5	514.5	375.7	3,154	514.5	514.5	375.7	3,154
17	78.2	67.9	550.9	520.0	382.0	3,123	550.9	520.0	382.0	3,123
18	77.5	68.0	499.0	499.0	362.9	3,123	499.0	499.0	362.9	3,123
19	76.3	69.3	379.7	379.7	265.8	3,123	379.7	379.7	265.8	3,123
20	74.7	70.0	348.0	348.0	243.3	3,123	348.0	348.0	243.3	3,123
21	72.7	69.0	290.0	290.0	200.9	3,123	290.0	290.0	200.9	3,123
22	70.6	67.3	190.0	190.0	138.7	3,123	190.0	190.0	138.7	3,123
23	68.3	65.4	0.0	400.0	374.3	3,521	0.0	400.0	374.3	3,521
24	66.1	63.6	0.0	400.0	368.7	3,918	0.0	400.0	368.7	3,918

APPENDIX E

DETAILED ENERGY AND DEMAND DEVELOPEMENT AND CALCULATIONS

E.1 BASIS OF CALCULATIONS

Individual printouts of each ECO's energy usage (KWH) and component month-by-month peak electrical demand (KW) are contained in Appendix F. Also included therein is the same data for the Base Case of the centrifugal chiller.

The tabulations which follow use this data and data taken from the typical hour-by-hour demand curve for the Fort which was obtained from the utility company to estimate what the electric utility cost difference would be between a given ECO and the Base Case. The electric utility costs incurred are based upon the sum of the energy (KWH) costs and the demand (KW) costs. Each will be explained in turn.

a) Energy (KWH) Costs

Energy costs are simple to determine. The various components in the system each consume energy on a continuing basis. This continuous usage is tallied over a given monthly billing period and the resulting KWH total is then multiplied by the cost per KWH to obtain the energy cost. This procedure is independent of when during the day the energy was used. All usage is figured into the energy cost billed.

b) Demand (KW) Costs

The logic in calculation of demand costs is different. The factor which will determine a demand charge which appears on a monthly statement is the highest KW demand established over the preceding 12 months. This demand is typically established during mid-afternoons of summer months, when air conditioning systems are under peak loads. Therefore, it is very beneficial to minimize or eliminate KW loads during this period.

Therefore, in order to estimate the effect of a given system alternative on total billing demand it was necessary to estimate what the Fort's hourly base demand is during a peak month (taken as July) and then add to that the demands which would be established by that system's cooling plant. The sum of these at each hour is the total peak demand at that hour. The hour with the greatest demand is then taken as establishing the demand which will be billed for the next 12 months.

Using the historical demand curve previously referenced, the following figures were used to estimate base demand for the Fort during a peak day in July:

TIME	DEMAND (KW)
11 AM	26,600
12 NOON	28,000
1 PM	29,100
2 PM	30,000
3 PM	29,000
4 PM	28,400
5 PM	27,700

E.2 BASE CASE PROCEDURES AND RESULTS

Hourly chiller KW demand loads were calculated using a selected machine capacity of 900 tons and applying a part-load efficiency curve to the hourly loads calculated to occur during the design July afternoon period. The chiller was selected to have a peak efficiency of .73 KW per ton, which is a mid-range efficiency selection. Such a selection represents a good value between a high-efficiency chiller and one with a low first cost.

All other system components (pumps, cooling towers), being essentially non-modulating in nature, were taken as establishing their design demand KW throughout the design day afternoon. Energy consumption data were taken directly from the TRACE program output. The following table summarizes this data.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
Centr. Chiller	483	567	541	564	597	659	649
Cooling Tower	72	72	72	72	72	72	72
Cond. Water Pumps	15	15	15	15	15	15	15
Ch. Water Pumps	28	28	28	28	28	28	28
	27,198	28,682	29,756	30,679	29,712	29,174	28,464

Demand in excess of peak: 679 KWD
Demand cost over 12 months: $50,395 (at $6.185 per KWD)

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Total
KWHR usage for:					
Centr. Chiller	358,950	427,172	365,049	284,634	1,435,805

Annual KWHR Cost: $35,895 (at $.025 per KWHR)
Total Annual Utility Cost: $86,290

E.3 ICE HARVESTER SYSTEM ECO'S

The following five sub-sections present the results of demand and energy usage calculations for each ECO, displays the savings in demand and usage between that ECO and the base case, and applies the appropriate KWD and KWHR unit costs to those savings. A resulting annual utility cost savings is shown at the bottom of each tabulation.

It may be noted that one piece of equipment that is listed in the Appendix F energy and demand tabulations is the "Water Circulating Pump-Constant Volume." This pump only runs during the ice-making mode. Therefore, it is off during the hours from 11:00 a.m. to 5:00 p.m.

E.3.1 ECO IH-1

Comments: This system, while producing some demand and energy savings, does not look promising. The total annual savings of $9,485 is rather insignificant.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
630 Ton Chiller	452	461	465	466	467	465	460
Cooling Tower Fans	50	50	50	50	50	50	5050
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pumps	11	11	11	11	11	11	11
	28,141	28,550	29,654	30,555	29,556	28,954	28,249

Peak Demand Reduction Compared to Base Case:	124
Annual demand savings at $6.185 per KWD:	$9,203

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
630 Ton Chiller	350,261	438,155	361,489	274,636	1,424,541
Base case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case	8,689	-10,983	3,560	9,998	11,264

Annual energy savings @ $0.25 per KWHR	$282
TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO:	$9,485

E.3.2 ECO IH-2

Comments: Significant improvement over ECO IH-1, due to the peak KWD reduction resulting from the chiller, cooling tower, and condenser water pumps being turned off at the peak hour. There is, however, an increase in energy usage due to the size of the ice making chillers and the fact that it takes more energy to make ice than to chill water.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
1,150 Ton Chiller	455	0	0	0	0	0	0
Cooling Tower Fans	92	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	20	0	0	0	0	0	0
	27,195	28,028	29,128	30,028	29,028	28,428	27,728

Peak Demand reduction Compared to Base Case:	651
Annual Demand Savings at $6.185 per KWD:	$48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
1,150 Ton Chiller	394,773	493,612	423,914	333,373	1,645,672
Base case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case	-35,823	-66,440	-58,865	-48,739	-209,867

Annual energy savings @ $0.25 per KWHR ($5,247)

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $43,071

E.3.3 ECO IH-3

Comment: This system results in less energy savings than ECO IH-1. More energy is consumed because four hours of operation were shifted to ice-making from water chilling. As noted in the previous paragraph, ice-making uses more energy than water chilling. At the same time, the shift in usage did not produce a meaningful increase in KWD reduction.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
625 Ton Chiller	449	457	461	462	463	462	462
Cooling Tower Fans	50	50	50	50	50	50	50
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	11	11	11	11	11	11	11
	27,138	28,546	29,650	30,551	29,552	28,951	28,251

Peak Demand Reduction Compared to Base Case:	128
Annual Demand Savings at $6.185 per KWD:	$9,500

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
625 Ton Chiller	354,982	460,020	359,978	275,994	1,405,974
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	3,968	-32,848	5,071	8,640	-15,169

Annual Energy Savings at $.025 per KWHR:	($379)
Annual utility cost savings for this ECO:	$9,121

E.3.4 ECO IH-4

Comments: The results of this system compared to ECO IH-2 are very similar to the results of ECO IH-3 compared to ECO IH-1. There is a very small reduction in energy savings which results from shifting four hours of water chilling to ice-building. This is again due to the relative energy inefficiency of ice building, as compared to water chilling. Demand reduction, on the other hand, did not change.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
975 Ton Chiller	454	0	0	0	0	0	0
Cooling Tower Fans	78	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	16	0	0	0	0	0	0
	27,176	28,028	29,128	30,028	29,028	28,028	27,728

Peak Demand Reduction Compared to Base Case:	651
Annual Demand Savings at $6.185 per KWD:	$48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
975 Ton Chiller	398,148	505,719	426,572	322,145	1,652,584
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	-39,198	-78,547	-61,523	-37,511	-216,779

Annual Energy Savings at $.025 per KWHR: ($5,419)

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $42,898

E.3.5 ECO IH-5

Comments: As might be expected, the narrowing of the demand "window" during which ice must be available to carry load from six hours to three hours results in the greatest energy savings. This is because less ice-making time at night is needed and, therefore, ice-making inefficiencies are minimized.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
820 Ton Chiller	463	560	0	0	0	606	599
Cooling Tower Fans	66	66	0	0	0	66	66
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	14	14	0	0	0	14	14
	27,171	28,668	29,128	30,028	29,028	29,114	28,407

Peak Demand Reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
820 Ton Chiller	358,977	453,487	379,911	297,877	1,490,252
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	-27	-26,315	-14,862	-13,243	-54,447

Annual Energy Savings at $.025 per KWHR: ($1,361)
TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $46,956

E.3.6 SUMMARY TABLE

ECO	Annual Utility Savings Compared to Base Case	
IH-1	$	9,485
IH-2	$	43,071
IH-3	$	9,121
IH-4	$	42,898
IH-5	$	46,956

E.4 ICE TANK SYSTEM ECO'S:

The following sub-sections are arranged in the same manner as those in Section E.3. Inasmuch as the components associated with the night chiller system only run at night, none of them (the chiller, cooling tower, condenser water pump) are listed in the demand tabulations.

E.4.1 ECO IT-1

Comments: Savings achieved by this system are rather modest, due to the fact that no equipment is turned off during the peak demand period. Demand reduction, though, is better than that achieved by the similar Ice Harvester System IH-1. Annual savings achieved by this ECO amount of $15,200.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
500 Ton Chiller	384	391	394	395	396	395	390
Cooling Tower Fans	41	41	41	41	41	41	41
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	14	14	14	14	14	14	14
	27,067	28,474	29,577	30,478	29,479	28,878	28173

Peak Demand Reduction Compared to Base Case:	201
Annual Demand Savings at $6.185 per KWD:	$14,918

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
500 Ton Chiller	350,261	438,155	361,489	274,636	1,424,541
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	8,689	-10,983	3,560	9,998	11,264

Annual Energy Savings at $.025 per KWHR: $282

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $15,200

E.4.2 ECO IT-2

Comments: This shows that shifting the schedule to make more hours available for ice production with the resultant downsizing of the afternoon chiller load does have a beneficial effect. Savings increased from the $15,200 of ECO IT-1 to almost $20,000. Significant peak demand costs, however, are still incurred.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
450 Ton Chiller	346	352	355	356	356	356	351
Cooling Tower Fans	37	37	37	37	37	37	37
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	14	14	14	14	14	14	14
	27,025	28,431	29,534	30,435	29,435	28,835	28,130

Peak Demand Reduction Compared to Base Case:	244
Annual Demand Savings at $6.185 per KWD:	$18,110

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
450 Ton Chiller	328,168	426,614	350,686	256,216	1,361,684
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	30,782	558	14,363	28,418	74,121

Annual Energy Savings at $.025 per KWHR:	$1,853
TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO:	$19,963

E.4.3 ECO IT-3

Comments: This option clearly demonstrates the importance of eliminating all peak demands. In turning off the chilling plant during the projected peak demand hours, annual energy savings jumped from the $15,200 figure of ECO IT-1 to almost $49,000.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
810 Ton Chiller	496	0	0	0	0	0	0
Cooling Tower Fans	66	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	20	0	0	0	0	0	0
	27,210	28,028	29,128	30,028	29,028	28,428	27728

Peak Demand Reduction Compared to Base Case:	651
Annual Demand Savings at $6.185 per KWD:	$48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
810 Ton Chiller	336,084	435,802	366,197	288,333	1,426,416
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	22,866	-8,630	-1,148	-3,699	9,389

Annual Energy Savings at $.025 per KWHR: $235

TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $48,552

E.4.4 ECO IT-4

Comments: This option of keeping the same amount of afternoon off hours while lengthening the amount of time during which ice could be made showed a very marginal improvement in savings over ECO IT-3. Annual savings increased by less than $1,000, to roughly $49,400.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
635 Ton Chiller	456	0	0	0	0	0	0
Cooling Tower Fans	51	0	0	0	0	0	0
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	17	0	0	0	0	0	0
	27,152	28,028	29,128	30,028	29,028	28,428	27,728

Peak Demand Reduction Compared to Base Case: 651
Annual Demand Savings at $6.185 per KWD: $48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
635 Ton Chiller	328,844	430,629	358,020	276,736	1,394,229
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	30,106	-3,457	7,029	7,898	41,576

Annual Energy Savings at $.025 per KWHR: $1,039
TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO: $49,357

E.4.5 ECO IT-5

Comments: As might be expected, the "best case" approach of being able to shut down all systems only during three hours in the afternoon allowed the best annual savings to be achieved, approaching $50,000.

I. DEMAND COMPONENT

Hour	1100	1200	1300	1400	1500	1600	1700
Base Demand	26,600	28,000	29,100	30,000	29,000	28,400	27,700
520 Ton Chiller	399	407	0	0	0	411	406
Cooling Tower Fans	42	42	0	0	0	42	42
Ch. Water Pump	28	28	28	28	28	28	28
Cond. Water Pump	16	16	0	0	0	16	16
	27,085	28,493	29,128	30,028	29,028	28,897	28,192

Peak Demand Reduction Compared to Base Case:	651
Annual Demand Savings at $6.185 per KWD:	$48,317

II. ENERGY COMPONENT

Month	Jun	Jul	Aug	Sept	Annual
KWHR usage for:					
520 Ton Chiller	330,432	430,572	355,477	269,063	1,385,544
Base Case	358,950	427,172	365,049	284,634	1,435,805
Savings Compared to Base Case:	28,518	-3,400	9,572	15,571	50,261

Annual Energy Savings at $.025 per KWHR:	$1,257
TOTAL ANNUAL UTILITY COST SAVINGS FOR THIS ECO:	$49,574

APPENDIX F

ENERGY USAGE AND PEAK DEMAND COMPUTER PRINTOUTS

BASE CASE

CENTRIFUGAL CHILLER

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3
CONVENTIONAL CENTRIFUGAL CHILLER SYSTEM

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 G)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	358,950	887	955
July	427,172	969	1,298
Aug	365,049	873	961
Sept	284,634	775	641
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,435,804	969	3,855

Building Energy Consumption = 17,054 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 51,168 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
CONVENTIONAL CENTRIFUGAL CHILLER SYSTEM

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EB1001L	2-STG CENTRIFUGAL CHILLER >550 TONS												
	ELEC	0	0	0	0	0	177105	239266	177143	119148	0	0	0	712,661
	PK	0.0	0.0	0.0	0.0	0.0	565.7	657.3	551.6	453.2	0.0	0.0	0.0	657.3
1	EB5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	51867	53596	53596	38148	0	0	0	197,206
	PK	0.0	0.0	0.0	0.0	0.0	72.0	72.0	72.0	72.0	0.0	0.0	0.0	72.0
1	EB5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	955	1298	961	641	0	0	0	3,855
	PK	0.0	0.0	0.0	0.0	0.0	3.1	3.5	3.1	2.6	0.0	0.0	0.0	3.5
1	EB5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	20160	20832	20832	18480	0	0	0	80,304
	PK	0.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0	28.0	0.0	0.0	0.0	28.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
CONVENTIONAL CENTRIFUGAL CHILLER SYSTEM

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	10800	11160	11160	9900	0	0	0	43,020
	PK	0.0	0.0	0.0	0.0	0.0	15.0	15.0	15.0	15.0	0.0	0.0	0.0	15.0
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	720	744	744	660	0	0	0	2,868
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0

ECO IH-1

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	350,261	749	976
July	438,155	782	1,361
Aug	361,489	763	1,012
Sept	274,636	730	645
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,424,541	782	3,993

Building Energy Consumption = 16,921 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 50,767 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EB1001L		2-STG CENTRIFUGAL CHILLER >550 TONS											
	ELEC	0	0	0	0	0	180654	262895	186229	115924	0	0	0	745,702
	PK	0.0	0.0	0.0	0.0	0.0	456.8	476.6	454.0	435.9	0.0	0.0	0.0	476.6
1	EB5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	0	36307	37517	37517	27417	0	0	0	138,757
	PK	0.0	0.0	0.0	0.0	0.0	50.4	50.4	50.4	50.4	0.0	0.0	0.0	50.4
1	EB5100		COOLING TOWER FANS											
	WATER	0	0	0	0	0	976	1361	1012	645	0	0	0	3,993
	PK	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.4	2.4	0.0	0.0	0.0	2.4
1	EB5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	0	20160	20832	20832	19320	0	0	0	81,144
	PK	0.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0	28.0	0.0	0.0	0.0	28.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5010		CONDENSER WATER PUMP-CV(HIGH EFFIC.)											
	ELEC	0	0	0	0	0	7560	7812	7812	7245	0	0	0	30,429
	PK	0.0	0.0	0.0	0.0	0.0	10.5	10.5	10.5	10.5	0.0	0.0	0.0	10.5
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	0	720	744	744	690	0	0	0	2,898
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1	EQ5013		WATER CIRCULATING PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	0	6562	6781	6781	5742	0	0	0	25,866
	PK	0.0	0.0	0.0	0.0	0.0	27.3	27.3	27.3	27.3	0.0	0.0	0.0	27.3

ECO IH-2

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

MONTHLY ENERGY CONSUMPTION

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	394,773	1,051	966
July	493,612	1,269	1,396
Aug	423,914	1,137	1,071
Sept	333,373	1,034	727
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,645,672	1,269	4,160

Building Energy Consumption = 19,547 (Btu/Sq Ft/Year)　　Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 58,647 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS												
	ELEC	0	0	0	0	0	203429	295889	226191	157929	0	0	0	883,438
	PK	0.0	0.0	0.0	0.0	0.0	828.4	869.7	828.4	803.2	0.0	0.0	0.0	869.7
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	49705	51362	51362	38126	0	0	0	190,556
	PK	0.0	0.0	0.0	0.0	0.0	92.0	92.0	92.0	92.0	0.0	0.0	0.0	92.0
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	966	1396	1071	727	0	0	0	4,160
	PK	0.0	0.0	0.0	0.0	0.0	3.6	3.6	3.6	3.6	0.0	0.0	0.0	3.6
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	20160	20832	20832	18928	0	0	0	80,752
	PK	0.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0	28.0	0.0	0.0	0.0	28.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	10530	10881	10881	9672	0	0	0	41,964
	PK	0.0	0.0	0.0	0.0	0.0	19.5	19.5	19.5	19.5	0.0	0.0	0.0	19.5
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	720	744	744	676	0	0	0	2,884
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	11931	12329	12329	9744	0	0	0	46,333
	PK	0.0	0.0	0.0	0.0	0.0	49.7	49.7	49.7	49.7	0.0	0.0	0.0	49.7

ECO IH-3

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	354,982	745	960
July	460,020	778	1,378
Aug	359,978	759	969
Sept	275,994	730	636
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,450,974	778	3,943

Building Energy Consumption = 17,235 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 51,709 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS												
	ELEC	0	0	0	0	0	182382	281667	181625	114203	0	0	0	759,878
	PK	0.0	0.0	0.0	0.0	0.0	474.9	504.8	477.4	433.1	0.0	0.0	0.0	504.8
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	36019	37219	37219	27215	0	0	0	137,672
	PK	0.0	0.0	0.0	0.0	0.0	50.0	50.0	50.0	50.0	0.0	0.0	0.0	50.0
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	960	1378	969	636	0	0	0	3,943
	PK	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.4	2.4	0.0	0.0	0.0	2.4
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	20160	20832	20832	19320	0	0	0	81,144
	PK	0.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0	28.0	0.0	0.0	0.0	28.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
12 HOUR ICE BUILD, 12 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	7560	7812	7812	7245	0	0	0	30,429
	PK	0.0	0.0	0.0	0.0	0.0	10.5	10.5	10.5	10.5	0.0	0.0	0.0	10.5
1	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	720	744	744	690	0	0	0	2,898
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1	E05013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	9843	10171	10171	9023	0	0	0	39,209
	PK	0.0	0.0	0.0	0.0	0.0	27.3	27.3	27.3	27.3	0.0	0.0	0.0	27.3

ECO IH-4

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

MONTHLY ENERGY CONSUMPTION

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	398,148	1,048	987
July	505,719	1,117	1,412
Aug	426,572	1,051	1,079
Sept	322,145	1,030	724
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,652,584	1,117	4,202

Building Energy Consumption = 19,629 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 58,894 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS												
	ELEC	0	0	0	0	0	213085	314486	235339	159344	0	0	0	922,254
	PK	0.0	0.0	0.0	0.0	0.0	742.1	788.8	746.0	724.4	0.0	0.0	0.0	788.8
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	42142	43546	43546	27714	0	0	0	156,948
	PK	0.0	0.0	0.0	0.0	0.0	78.0	78.0	78.0	78.0	0.0	0.0	0.0	78.0
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	987	1412	1079	724	0	0	0	4,202
	PK	0.0	0.0	0.0	0.0	0.0	3.1	3.3	3.1	3.1	0.0	0.0	0.0	3.3
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	20160	20832	20832	17640	0	0	0	79,464
	PK	0.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0	28.0	0.0	0.0	0.0	28.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
12 HOUR ICE BUILD, 6 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	8532	8816	8816	7110	0	0	0	33,275
	PK	0.0	0.0	0.0	0.0	0.0	15.8	15.8	15.8	15.8	0.0	0.0	0.0	15.8
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	720	744	744	630	0	0	0	2,838
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	15212	15719	15719	11409	0	0	0	58,060
	PK	0.0	0.0	0.0	0.0	0.0	42.3	42.3	42.3	42.3	0.0	0.0	0.0	42.3

ECO IH-5

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	358,977	892	942
July	453,487	913	1,359
Aug	379,911	877	1,011
Sept	297,877	774	678
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,490,252	913	3,990

Building Energy Consumption = 17,701 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 53,109 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001L		2-STG CENTRIFUGAL CHILLER >550 TONS											
	ELEC	0	0	0	0	0	181593	270190	196615	133902	0	0	0	782,300
	PK	0.0	0.0	0.0	0.0	0.0	589.6	619.0	589.6	571.6	0.0	0.0	0.0	619.0
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	0	41349	42728	42728	31341	0	0	0	158,146
	PK	0.0	0.0	0.0	0.0	0.0	65.6	65.6	65.6	65.6	0.0	0.0	0.0	65.6
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	0	942	1359	1011	678	0	0	0	3,990
	PK	0.0	0.0	0.0	0.0	0.0	3.1	3.2	3.1	2.6	0.0	0.0	0.0	3.2
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	0	20160	20832	20832	18928	0	0	0	80,752
	PK	0.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0	28.0	0.0	0.0	0.0	28.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
8 HOUR ICE BUILD, 13 HOUR CHILLER RUN

E Q U I P M E N T E N E R G Y C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E85010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	8505	8788	8788	7911	0	0	0	33,993
	PK	0.0	0.0	0.0	0.0	0.0	13.5	13.5	13.5	13.5	0.0	0.0	0.0	13.5
1	E85300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	720	744	744	676	0	0	0	2,884
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1	E85013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	8352	8630	8630	6821	0	0	0	32,433
	PK	0.0	0.0	0.0	0.0	0.0	34.8	34.8	34.8	34.8	0.0	0.0	0.0	34.8

ECO IT-1

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	323,900	648	994
July	419,084	859	1,391
Aug	344,432	647	1,073
Sept	258,791	637	701
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,346,207	859	4,160

Building Energy Consumption = 15,990 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 47,975 (Btu/Sq Ft/Year)

Trane Air Conditioning Economics
By: C.D.S. MARKETING

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	21564	38101	23317	9250	0	0	0	92,232
	PK	0.0	0.0	0.0	0.0	0.0	127.0	297.2	196.8	99.5	0.0	0.0	0.0	297.2
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	7778	8037	8037	3259	0	0	0	27,110
	PK	0.0	0.0	0.0	0.0	0.0	32.4	32.4	32.4	32.4	0.0	0.0	0.0	32.4
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	113	213	126	37	0	0	0	489
	PK	0.0	0.0	0.0	0.0	0.0	0.7	1.6	1.1	0.6	0.0	0.0	0.0	1.6
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Trane Air Conditioning Economics
By: C.D.S. MARKETING

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
8 HOUR ICE BUILD, 16 HOUR CHILLER RUN

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E95010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	240	248	248	240	0	0	0	976
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
2	E01001S	2-STG CENTRIFUGAL CHILLER (550 TONS												
	ELEC	0	0	0	0	0	172858	242234	185728	126004	0	0	0	726,824
	PK	0.0	0.0	0.0	0.0	0.0	388.1	402.1	382.0	371.5	0.0	0.0	0.0	402.1
2	E05100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	22604	28194	24913	21198	0	0	0	96,908
	PK	0.0	0.0	0.0	0.0	0.0	40.5	40.5	40.5	40.5	0.0	0.0	0.0	40.5
2	E05100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	881	1178	948	664	0	0	0	3,671
	PK	0.0	0.0	0.0	0.0	0.0	2.0	2.0	1.9	1.9	0.0	0.0	0.0	2.0
2	E05001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	558	696	615	542	0	0	0	2,411
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0

ECO IT-2

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	328,168	606	992
July	426,614	830	1,402
Aug	350,686	631	1,085
Sept	256,216	596	691
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,361,684	830	4,170

Building Energy Consumption = 16,174 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 48,527 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	35030	60854	37450	16871	0	0	0	150,205
	PK	0.0	0.0	0.0	0.0	0.0	167.3	322.6	223.4	136.5	0.0	0.0	0.0	322.6
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	12031	12432	12432	6296	0	0	0	43,191
	PK	0.0	0.0	0.0	0.0	0.0	36.5	36.5	36.5	36.5	0.0	0.0	0.0	36.5
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	184	332	200	73	0	0	0	789
	PK	0.0	0.0	0.0	0.0	0.0	0.9	1.7	1.3	0.8	0.0	0.0	0.0	1.7
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
11 HOUR ICE BUILD, 13 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	330	341	341	300	0	0	0	1,312
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
2	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	162701	225941	177462	117431	0	0	0	683,536
	PK	0.0	0.0	0.0	0.0	0.0	349.3	361.9	343.8	334.3	0.0	0.0	0.0	361.9
2	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	19250	24791	20854	16553	0	0	0	81,447
	PK	0.0	0.0	0.0	0.0	0.0	36.5	36.5	36.5	36.5	0.0	0.0	0.0	36.5
2	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	809	1070	885	618	0	0	0	3,382
	PK	0.0	0.0	0.0	0.0	0.0	1.8	1.8	1.8	1.7	0.0	0.0	0.0	1.8
2	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	528	680	572	468	0	0	0	2,248
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0

ECO IT-3

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	336,084	864	962
July	435,802	1,118	1,394
Aug	366,197	1,047	1,067
Sept	288,333	883	729
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,426,416	1,118	4,152

Building Energy Consumption = 16,943 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 50,834 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	E01001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	21564	38101	23317	9250	0	0	0	92,232
	PK	0.0	0.0	0.0	0.0	0.0	127.0	297.2	196.8	99.5	0.0	0.0	0.0	297.2
1	E05100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	7778	8037	8037	3259	0	0	0	27,110
	PK	0.0	0.0	0.0	0.0	0.0	32.4	32.4	32.4	32.4	0.0	0.0	0.0	32.4
1	E05100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	113	213	126	37	0	0	0	489
	PK	0.0	0.0	0.0	0.0	0.0	0.7	1.6	1.1	0.6	0.0	0.0	0.0	1.6
1	E05001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
8 HOUR ICE BUILD, 10 HOUR CHILLER RUN

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	240	248	248	240	0	0	0	976
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
2	E01001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	176044	251545	197257	147362	0	0	0	772,209
	PK	0.0	0.0	0.0	0.0	0.0	584.5	631.1	584.5	566.6	0.0	0.0	0.0	631.1
2	E05100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	31500	35568	35043	29262	0	0	0	131,373
	PK	0.0	0.0	0.0	0.0	0.0	65.6	65.6	65.6	65.6	0.0	0.0	0.0	65.6
2	E05100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	849	1181	941	692	0	0	0	3,663
	PK	0.0	0.0	0.0	0.0	0.0	3.0	3.2	2.9	2.5	0.0	0.0	0.0	3.2
2	E05001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	660	728	720	662	0	0	0	2,770
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0

ECO IT-4

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	328,844	736	967
July	430,629	981	1,396
Aug	358,020	913	1,072
Sept	276,736	690	723
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,394,229	981	4,159

Building Energy Consumption = 16,561 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 49,687 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	35030	60854	37450	16871	0	0	0	150,205
	PK	0.0	0.0	0.0	0.0	0.0	167.3	322.6	223.4	136.5	0.0	0.0	0.0	322.6
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	12031	12432	12432	6296	0	0	0	43,191
	PK	0.0	0.0	0.0	0.0	0.0	36.5	36.5	36.5	36.5	0.0	0.0	0.0	36.5
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	184	332	200	73	0	0	0	789
	PK	0.0	0.0	0.0	0.0	0.0	0.9	1.7	1.3	0.8	0.0	0.0	0.0	1.7
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
11 HOUR ICE BUILD, 7 HOUR CHILLER RUN

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	330	341	341	300	0	0	0	1,312
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
2	E01001L	2-STG CENTRIFUGAL CHILLER >550 TONS												
	ELEC	0	0	0	0	0	160586	227981	180589	133281	0	0	0	702,437
	PK	0.0	0.0	0.0	0.0	0.0	473.0	500.4	474.6	459.2	0.0	0.0	0.0	500.4
2	E05100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	21957	26735	24956	21089	0	0	0	94,736
	PK	0.0	0.0	0.0	0.0	0.0	50.8	50.8	50.8	50.8	0.0	0.0	0.0	50.8
2	E05100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	784	1064	872	651	0	0	0	3,371
	PK	0.0	0.0	0.0	0.0	0.0	2.4	2.5	2.4	2.4	0.0	0.0	0.0	2.5
2	E05001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	612	712	677	602	0	0	0	2,603
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0

ECO IT-5

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

------------------------------------ M O N T H L Y   E N E R G Y   C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	WATER (1000 Gl)
Jan	0	0	0
Feb	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	330,432	659	987
July	430,572	887	1,401
Aug	355,477	821	1,079
Sept	269,063	649	717
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	1,385,543	887	4,184

Building Energy Consumption = 16,457 (Btu/Sq Ft/Year)   Floor Area = 287,340 (Sq Ft)
Source Energy Consumption = 49,377 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Monthly Consumption Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	0	0	0	0	0	98298	101575	101575	98298	0	0	0	399,745
	PK	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0	0.0	0.0	0.0	250.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S		2-STG CENTRIFUGAL CHILLER (550 TONS											
	ELEC	0	0	0	0	0	35030	60854	37450	16871	0	0	0	150,205
	PK	0.0	0.0	0.0	0.0	0.0	167.3	322.6	223.4	136.5	0.0	0.0	0.0	322.6
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	0	12031	12432	12432	6296	0	0	0	43,191
	PK	0.0	0.0	0.0	0.0	0.0	36.5	36.5	36.5	36.5	0.0	0.0	0.0	36.5
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	0	184	332	200	73	0	0	0	789
	PK	0.0	0.0	0.0	0.0	0.0	0.9	1.7	1.3	0.8	0.0	0.0	0.0	1.7
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
11 HOUR ICE BUILD, 10 HOUR CHILLER RUN

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	330	341	341	300	0	0	0	1,312
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
2	E01001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	0	163950	229271	180253	128004	0	0	0	701,478
	PK	0.0	0.0	0.0	0.0	0.0	403.3	418.2	394.0	384.8	0.0	0.0	0.0	418.2
2	E05100	COOLING TOWER FANS												
	ELEC	0	0	0	0	0	20222	25404	22792	18753	0	0	0	87,171
	PK	0.0	0.0	0.0	0.0	0.0	42.1	42.1	42.1	42.1	0.0	0.0	0.0	42.1
2	E05100	COOLING TOWER FANS												
	WATER	0	0	0	0	0	804	1069	879	644	0	0	0	3,395
	PK	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	2.0
2	E05001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	E05300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	0	570	696	634	542	0	0	0	2,442
	PK	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0

APPENDIX G

CONCEPTUAL COST ESTIMATES

BASE CASE ESTIMATE

CENTRIFUGAL CHILLER

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE CC-1
Date:	August 02, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	OST/UNI	TOTAL HRS	TOTAL COST	TOTAL
	CHILLER	900	TONS	$180.00	$162,000.00	1.00	$80.00		$72,000.00	$234,000.00
	CLG TWR (900 TONS)	900	EA	$40.00	$36,000.00	1.00	$6.25		$5,625.00	$41,625.00
										$0.00
	VENTILATION SYSTEM	1	LS							$1,000.00
	REFRIGERATION MONIT	1	LS							$4,500.00
										$0.00
	CHILLED WTR SYSTEM									$0.00
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00		$900.00	$4,703.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50		$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65		$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05		$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05		$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00		$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00		$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS							$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15		$25,260.00	$42,260.00
	2" PIPING	50	LF	$5.30	$265.00	0.12	$5.90		$295.00	$560.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40		$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00		$3,200.00	$4,092.00
	2" INSULATION	50	LF	$0.80	$40.00	0.08	$4.00		$200.00	$240.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50		$175.00	$189.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00		$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05		$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35		$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55		$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00		$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$2,093.00	$2,093.00	8.00	$400.00		$400.00	$2,493.00

Subtotals:	$230,821.35		$111,742.25	$350,063.60
Sales Tax:	$0.00	Overhead:	10%	$35,006.36
		Profit:	10%	$38,507.00
		Subtotal:		$423,576.96
		Bond:		$0.00
		Contingen	15%	$63,536.54
		Grand Total:		$487,113.50

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE CC-1
Date:	April 10, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	CONDENSER WTR SYS									
	PUMPS 2160 GPM	1	EA	$5,900.00	$5,900.00	24.00	$1,200.00	24.00	$1,200.00	$7,100.00
	GRISWOLD SEPARATOR	1	EA	$5,850.00	$5,850.00	8.00	$400.00	8.00	$400.00	$6,250.00
	10" BUTTERFLY VALVE	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50	0.75	$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20	0.44	$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35	0.73	$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05	2.53	$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00	13.50	$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55	1.14	$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05	2.95	$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00	600.00	$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60	18.60	$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10	2.62	$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55	2.27	$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75	1.85	$92.25	$146.40
	CHEM FEED PUMP/TAN	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50	0.75	$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00	4.00	$200.00	$570.00
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00	8.00	$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	6.00	$300.00	6.00	$300.00	$1,353.00
	PROJ MAN/MISC COSTS	1	LS							$34,400.00
	SEISMIC	1	LS							$7,500.00
	CONTROLS	1	LS							$60,000.00
	BALANCING	1	LS							$4,000.00

Subtotals:		$50,493.15		734.62	$36,730.80	$195,123.95
Sales Tax:		$0.00				
			Overhead:		10%	$19,512.40
			Profit:		10%	$19,512.40
			Subtotal:			$234,148.74
			Bond:			$0.00
			Contingency:		15%	$35,122.31
			Grand Total:			$269,271.05

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. CC-1
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
13	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
14	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
15	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
16	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
17	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
18	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
19	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
20	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Surge Tank Pump-50hp				$0.00		$0.00	0.00	$0.00	$0.00
21	#1 thwn cu. conductor	150	L.F.	$1.60	$244.32	0.12	$3.75	17.27	$561.99	$806.31
22	1 1/2" EMT conduit	40	L.F.	$1.90	$77.37	0.18	$5.86	7.20	$234.34	$311.71
23	175amp fuse	3	EA	$21.00	$64.13	0.60	$19.53	1.80	$58.58	$122.72
24	Connection to Equipment	1	EA	$160.50	$163.39	12.00	$390.56	12.00	$390.56	$553.95
25	Combo. Starter/Disc.	1	EA	$1,400.00	$1,425.20	11.00	$358.02	11.00	$358.02	$1,783.22
26	1 1/2" Flex Conduit	5	L.F.	$1.80	$9.16	0.54	$17.58	2.70	$87.88	$97.04
27	1 1/2" Flex Connector	2	EA	$9.50	$19.34	0.42	$13.67	0.84	$27.34	$46.68
28	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-25hp				$0.00		$0.00	0.00	$0.00	$0.00
37	#4 thwn cu. conductor	180	L.F.	$0.39	$71.46	0.02	$0.65	3.60	$117.17	$188.63
38	1 1/4" EMT conduit	50	L.F.	$1.21	$61.59	0.08	$2.60	4.00	$130.19	$191.78
39	90amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
40	Connection to Equipment	1	EA	$30.00	$30.54	4.09	$133.17	4.09	$133.17	$163.71
41	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
42	1 1/4" Flex Conduit	5	L.F..	$1.07	$5.45	0.11	$3.58	0.55	$17.90	$23.35
43	1 1/4" Flex Connector	2	EA	$6.38	$12.99	0.20	$6.51	0.40	$13.02	$26.01
44	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:		$11,244.79	269.37	$8,767.32	$20,012.10
Sales Tax:	0%	$0.00			

Overhead:	10%	$2,001.21
Profit:	10%	$2,201.33
Subtotal:		$24,214.65
Bond:	0%	$0.00
Contingency:	10%	$2,421.46
Grand Total:		$26,636.11

ICE HARVESTER SYSTEM

COST ESTIMATES

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-1
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
# DESCRIPTION	QTY.	UNIT		COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
ICE HARVESTOR	485	TONS		$1,250.00	$606,250.00	3.50	$175.00	1697.50	$84,875.00	$691,125.00
CLG TWR-630 TONS	1	EA		$17,000.00	$17,000.00	100.00	$5,000.00	100.00	$5,000.00	$22,000.00
HOISTING	1	LS			$0.00		$0.00	0.00	$0.00	$8,000.00
TANK	1	EA			$0.00		$0.00	0.00	$0.00	$49,725.00
PLATE HEAT EXCHNGR	1	EA		$14,328.00	$14,328.00	80.00	$4,000.00	80.00	$4,000.00	$18,328.00
					$0.00		$0.00	0.00	$0.00	$0.00
CHILLED WTR SYSTEM					$0.00		$0.00	0.00	$0.00	$0.00
PUMPS 1440 GPM	1	EA		$3,803.00	$3,803.00	18.00	$900.00	18.00	$900.00	$4,703.00
					$0.00		$0.00	0.00	$0.00	$0.00
8" BUTTERFLY VALVES	6	EA		$345.00	$2,070.00	5.33	$266.50	31.98	$1,599.00	$3,669.00
THERMOMETERS	2	EA		$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
PRESSURE GAGES	2	EA		$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
RELIEF VALVES	1	EA		$79.00	$79.00	0.33	$16.65	0.33	$16.65	$95.65
1" BALL VALVES	8	EA		$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
GAGE COCKS	5	EA		$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
8" AIR SEPARATOR	1	EA		$2,525.00	$2,525.00	8.00	$400.00	8.00	$400.00	$2,925.00
FLEXIBLE CONNECTOR	2	EA		$232.00	$464.00	4.00	$200.00	8.00	$400.00	$864.00
CHEMICAL POT FEEDER	1	ls			$0.00		$0.00	0.00	$0.00	$2,000.00
8" PIPING	400	LF		$42.50	$17,000.00	1.26	$63.15	505.20	$25,260.00	$42,260.00
2" PIPING	100	LF		$5.30	$530.00	0.12	$5.90	11.80	$590.00	$1,120.00
3/4" PIPING	50	LF		$2.08	$104.00	0.11	$5.40	5.40	$270.00	$374.00
8" INSULATION	400	LF		$2.23	$892.00	0.16	$8.00	64.00	$3,200.00	$4,092.00
2" INSULATION	100	LF		$0.80	$80.00	0.08	$4.00	8.00	$400.00	$480.00
3/4" INSULATION	50	LF		$0.28	$14.00	0.07	$3.50	3.50	$175.00	$189.00
					$0.00		$0.00	0.00	$0.00	$0.00
150 GAL EXP TANK	1	EA		$845.00	$845.00	4.00	$200.00	4.00	$200.00	$1,045.00
FILL VALVE ASSEMBLY	1	EA		$113.00	$113.00	0.42	$21.05	0.42	$21.05	$134.05
MANUAL AIR VENT	1	EA		$35.00	$35.00	0.67	$33.35	0.67	$33.35	$68.35
1" STRAINER	1	EA		$13.75	$13.75	0.47	$23.55	0.47	$23.55	$37.30
TRIPLE DUTY VALVE	1	EA		$1,338.00	$1,338.00	6.00	$300.00	6.00	$300.00	$1,638.00
SUCTION DIFFUSER	1	EA		$1,205.00	$1,205.00	5.00	$250.00	5.00	$250.00	$1,455.00
Subtotals:					$668,946.35			2564.75	$128,237.25	$856,908.60
Sales Tax:					$0.00					

Overhead:	10%	$85,690.86
Profit:	10%	$94,259.95
Subtotal:		$1,036,859.41
Bond:		$0.00
Contingency:	15%	$155,528.91
Grand Total:		$1,192,388.32

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-1
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	CONDENSER WTR SYS				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1510 GPM	1	EA	$2,693.00	$2,693.00	18.00	$900.00	18.00	$900.00	$3,593.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00	8.00	$400.00	$5,150.00
	10" BUTTERFLY VALVE	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50	0.75	$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20	0.44	$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35	0.73	$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05	2.53	$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00	13.50	$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55	1.14	$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05	2.95	$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00	600.00	$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60	18.60	$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10	2.62	$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55	2.27	$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75	1.85	$92.25	$146.40
	CHEM FEED PUMP/TANK	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50	0.75	$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00	4.00	$200.00	$570.00
					$0.00		$0.00	0.00	$0.00	$0.00
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	8.00	$400.00	8.00	$400.00	$1,738.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	6.00	$300.00	6.00	$300.00	$1,505.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$45,468.15			728.62	$36,430.80	$83,898.95
	Sales Tax:				$0.00					

Overhead:	10%	$8,389.90
Profit:	10%	$8,389.90
Subtotal:		$100,678.74
Bond:		$0.00
Contingency:	15%	$15,101.81
Grand Total:		$115,780.55

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-1
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	TANK PUMPING SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	VERT TURBINE PUMPS				$0.00		$0.00	0.00	$0.00	$0.00
	2330 GPM	1	EA	$9,740.00	$9,740.00	60.00	$3,000.00	60.00	$3,000.00	$12,740.00
	10" BUTTERFLY VALVES	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.50	0.33	$16.50	$95.50
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	FLEXIBLE CONNECTORS	1	EA	$340.00	$340.00	4.50	$225.00	4.50	$225.00	$565.00
	FLEXIBLE CONNECTORS	1	EA	$52.00	$52.00	0.50	$25.00	0.50	$25.00	$77.00
	2-WAY CONTROL VALVE	1	EA	$365.00	$365.00	0.75	$37.50	0.75	$37.50	$402.50
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	10" PIPING	150	LF	$73.00	$10,950.00		$0.00	0.00	$0.00	$10,950.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	10" INSULATION	150	LF	$2.60	$390.00	0.18	$8.90	26.70	$1,335.00	$1,725.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	PROJ. MAN. / MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$24,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	SEISMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$90,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
Subtotals:					$24,723.60			135.25	$6,762.65	$159,486.25
Sales Tax:					$0.00					

Overhead:	10%	$15,948.63
Profit:	10%	$15,948.63
Subtotal:		$191,383.50
Bond:		$0.00
Contingency:	15%	$28,707.53
Grand Total:		$220,091.03

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IH-1
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #4, cu. wir	180	L.F.	$1.00	$183.90	0.04	$1.30	7.20	$234.34	$418.24
3	Cable Termination	12	EA	$60.00	$732.96	0.93	$30.11	11.10	$361.27	$1,094.23
4	Grounding	1	EA	$200.00	$203.60	1.85	$60.05	1.85	$60.05	$263.65
5	1 1/2" emt Conduit	40	L.F.	$1.43	$58.23	0.09	$2.90	3.56	$115.87	$174.10
6	1 1/2" emt Connector	6	EA	$0.61	$3.73	0.07	$2.18	0.40	$13.08	$16.81
7	1 1/2" Conduit Hanger	4	EA	$1.25	$5.09	0.05	$1.72	0.21	$6.90	$11.99
8	1 1/2" Flex Conduit	5	L.F.	$0.31	$1.58	0.04	$1.30	0.20	$6.51	$8.09
9	1 1/2" Flex Connector	2	EA	$1.00	$2.04	0.10	$3.25	0.20	$6.51	$8.55
10	5kv Fuse	3	EA	$240.00	$732.96	0.40	$13.02	1.20	$39.06	$772.02
11	Connection to Equipment	1	EA	$40.00	$40.72	8.00	$260.38	8.00	$260.38	$301.10
					$0.00		$0.00	0.00	$0.00	$0.00
	Cooling Tower Fan-40hp				$0.00		$0.00	0.00	$0.00	$0.00
12	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
13	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
14	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
15	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
16	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
17	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
18	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
19	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
20	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
21	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
22	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
23	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
24	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
25	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
26	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
27	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Surge Tank Pump-30hp				$0.00		$0.00	0.00	$0.00	$0.00
28	#2 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
29	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
30	120amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
31	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
32	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
33	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
34	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
35	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-20hp				$0.00		$0.00	0.00	$0.00	$0.00
36	#3 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
37	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
38	80amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
39	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
40	Combo. Starter/Disc.	1	EA	$852.65	$868.00	7.01	$228.00	7.01	$228.00	$1,096.00
41	1 1/4" Flex Conduit	5	L.F.	$1.05	$5.34	0.11	$3.71	0.57	$18.55	$23.90
42	1 1/4" Flex Connector	2	EA	$6.25	$12.73	0.20	$6.51	0.40	$13.02	$25.74
43	100amp switch in Panel	1	EA	$525.45	$534.91	2.00	$65.09	2.00	$65.09	$600.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
			Subtotals:		$11,486.46			214.45	$6,979.65	$18,466.10
			Sales Tax:	0%	$0.00					

Overhead:	10%	$1,846.61
Profit:	10%	$2,031.27
Subtotal:		$22,343.98
Bond:	0%	$0.00
Contingency:	10%	$2,234.40
Grand Total:		$24,578.38

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-2
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	OST/UNI	TOTAL HRS	TOTAL COST	TOTAL
	ICE HARVESTOR	885	TONS	$1,250.00	$1,106,250.00	3.50	$175.00	3097.50	$154,875.00	$1,261,125.00
	CLG TWR (1150 TONS)	1	EA	$21,000.00	$21,000.00	120.00	$6,000.00	120.00	$6,000.00	$27,000.00
	HOISTING	1	LS		$0.00		$0.00	0.00	$0.00	$8,000.00
	TANK	1	EA		$0.00		$0.00	0.00	$0.00	$97,825.00
	PLATE HEAT EXCHR	1	EA	#######	$51,974.00	120.00	#######	120.00	$6,000.00	$57,974.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CHILLED WTR SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00	18.00	$900.00	$4,703.00
					$0.00		$0.00	0.00	$0.00	$0.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50	31.98	$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65	0.33	$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00	8.00	$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00	8.00	$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15	505.20	$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90	11.80	$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40	5.40	$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00	64.00	$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00	8.00	$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50	3.50	$175.00	$189.00
					$0.00		$0.00	0.00	$0.00	$0.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00	4.00	$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05	0.42	$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35	0.67	$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55	0.47	$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	8.00	$400.00	8.00	$400.00	$1,738.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	6.00	$300.00	6.00	$300.00	$1,505.00

Subtotals:	$1,210,592.35	4027.75	$201,387.25	$1,519,804.60
Sales Tax:	$0.00			

Overhead:	10%	$151,980.46
Profit:	10%	$167,178.51
Subtotal:		$1,838,963.57
Bond:		$0.00
Contingenc	15%	$275,844.53
Grand Total:		$2,114,808.10

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-2
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	CONDENSER WTR SYS				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 2760 GPM	1	EA	$2,693.00	$2,693.00	24.00	$1,200.00	24.00	$1,200.00	$3,893.00
	GRISWOLD SEPARATOR	1	EA	$5,850.00	$5,850.00	8.00	$400.00	8.00	$400.00	$6,250.00
	10" BUTTERFLY VALVES	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50	0.75	$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20	0.44	$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35	0.73	$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05	2.53	$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00	13.50	$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55	1.14	$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05	2.95	$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00	600.00	$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60	18.60	$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10	2.62	$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55	2.27	$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75	1.85	$92.25	$146.40
	CHEM FEED PUMP/TANK	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50	0.75	$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00	4.00	$200.00	$570.00
					$0.00		$0.00	0.00	$0.00	$0.00
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00	6.00	$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	5.00	$250.00	5.00	$250.00	$1,455.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$46,568.15			731.62	$36,580.80	$85,148.95
	Sales Tax:				$0.00					

Overhead:	10%	$8,514.90
Profit:	10%	$8,514.90
Subtotal:		$102,178.74
Bond:		$0.00
Contingency:	15%	$15,326.81
Grand Total:		$117,505.55

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-2
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	TANK PUMPING SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	VERT TURBINE PUMPS				$0.00		$0.00	0.00	$0.00	$0.00
	4250 GPM	1	EA	$13,835.00	$13,835.00	60.00	$3,000.00	60.00	$3,000.00	$16,835.00
	12" BUTTERFLY VALVES	6	EA	$595.00	$3,570.00	8.00	$400.00	48.00	$2,400.00	$5,970.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.50	0.33	$16.50	$95.50
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	FLEXIBLE CONNECTORS	1	EA	$340.00	$340.00	4.50	$225.00	4.50	$225.00	$565.00
	FLEXIBLE CONNECTOR	1	EA	$52.00	$52.00	0.50	$25.00	0.50	$25.00	$77.00
	2-WAY CONTROL VALVE	1	EA	$365.00	$365.00	0.75	$37.50	0.75	$37.50	$402.50
					$0.00		$0.00	0.00	$0.00	$0.00
	12" PIPING	200	LF	$94.00	$18,800.00	1.71	$85.70	342.80	$17,140.00	$35,940.00
	10" PIPING	200	LF	$73.00	$14,600.00	1.50	$75.00	300.00	$15,000.00	$29,600.00
					$0.00		$0.00	0.00	$0.00	$0.00
	12" INSULATION	200	LF	$2.96	$592.00	0.20	$10.00	40.00	$2,000.00	$2,592.00
	10" INSULATION	200	LF	$2.60	$520.00	0.18	$8.90	35.60	$1,780.00	$2,300.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	PROJ MAN/MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$39,900.00
					$0.00		$0.00	0.00	$0.00	$0.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$146,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:	$53,010.60	838.95	$41,947.65	$294,858.25
Sales Tax:	$0.00			

Overhead:	10%	$29,485.83
Profit:	10%	$29,485.83
Subtotal:		$353,829.90
Bond:		$0.00
Contingency:	15%	$53,074.49
Grand Total:		$406,904.39

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IH-2
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
13	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
14	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
15	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
16	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
17	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
18	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
19	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
20	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Cooling Tower Fan-30hp				$0.00		$0.00	0.00	$0.00	$0.00
21	#2 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
22	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
23	120amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
24	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
25	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
26	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
27	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
28	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Cooling Tower Fan-30hp				$0.00		$0.00	0.00	$0.00	$0.00
29	#2 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
30	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
31	120amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
32	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
33	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
34	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
35	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
36	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-20hp				$0.00		$0.00	0.00	$0.00	$0.00
37	#3 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
38	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
39	80amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
40	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
41	Combo. Starter/Disc.	1	EA	$852.65	$868.00	7.01	$228.00	7.01	$228.00	$1,096.00
42	1 1/4" Flex Conduit	5	L.F.	$1.05	$5.34	0.11	$3.71	0.57	$18.55	$23.90
43	1 1/4" Flex Connector	2	EA	$6.25	$12.73	0.20	$6.51	0.40	$13.02	$25.74
44	100amp switch in Panel	1	EA	$525.45	$534.91	2.00	$65.09	2.00	$65.09	$600.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Cond. Water Pump-20hp				$0.00		$0.00	0.00	$0.00	$0.00
45	#3 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
46	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
47	80amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
48	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
49	Combo. Starter/Disc.	1	EA	$852.65	$868.00	7.01	$228.00	7.01	$228.00	$1,096.00
50	1 1/4" Flex Conduit	5	L.F.	$1.05	$5.34	0.11	$3.71	0.57	$18.55	$23.90
51	1 1/4" Flex Connector	2	EA	$6.25	$12.73	0.20	$6.51	0.40	$13.02	$25.74
52	100amp switch in Panel	1	EA	$525.45	$534.91	2.00	$65.09	2.00	$65.09	$600.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Surge Tank Pump-50hp				$0.00		$0.00	0.00	$0.00	$0.00
53	#1 thwn cu. conductor	150	L.F.	$1.60	$244.32	0.12	$3.75	17.27	$561.99	$806.31
54	1 1/2" EMT conduit	40	L.F.	$1.90	$77.37	0.18	$5.86	7.20	$234.34	$311.71
55	175amp fuse	3	EA	$21.00	$64.13	0.60	$19.53	1.80	$58.58	$122.72
56	Connection to Equipment	1	EA	$160.50	$163.39	12.00	$390.56	12.00	$390.56	$553.95
57	Combo. Starter/Disc.	1	EA	$1,400.00	$1,425.20	11.00	$358.02	11.00	$358.02	$1,783.22
58	1 1/2" Flex Conduit	5	L.F.	$1.80	$9.16	0.54	$17.58	2.70	$87.88	$97.04
59	1 1/2" Flex Connector	2	EA	$9.50	$19.34	0.42	$13.67	0.84	$27.34	$46.68
60	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38
61	New 1000kva Transforme	1	EA	$15,000.0	$15,270.00	54.25	$1,765.67	54.25	$1,765.67	$17,035.67
62	Remove Existing Trans.	1	EA	$3,000.00	$3,054.00	10.00	$325.47	10.00	$325.47	$3,379.47

Subtotals:		$35,403.45	398.07	$12,956.08	$48,359.53
Sales Tax:	0%	$0.00			

Overhead:	10%	$4,835.95
Profit:	10%	$5,319.55
Subtotal:		$58,515.04
Bond:	0%	$0.00
Contingency:	10%	$5,851.50
Grand Total:		$64,366.54

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-3
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE HARVESTOR	485	TONS	$1,250.00	$606,250.00	3.50	$175.00	1697.50	$84,875.00	$691,125.00
	CLG TWR-625 TONS	1	EA	$22,500.00	$22,500.00	110.00	$5,500.00	110.00	$5,500.00	$28,000.00
	HOISTING	1	LS		$0.00		$0.00	0.00	$0.00	$8,000.00
	TANK	1	EA		$0.00		$0.00	0.00	$0.00	$54,275.00
	PLATE HEAT EXCHNGR	1	EA	$14,127.00	$14,127.00	80.00	$4,000.00	80.00	$4,000.00	$18,127.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CHILLED WTR SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00	18.00	$900.00	$4,703.00
					$0.00		$0.00	0.00	$0.00	$0.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50	31.98	$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65	0.33	$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00	8.00	$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00	8.00	$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15	505.20	$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90	11.80	$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40	5.40	$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00	64.00	$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00	8.00	$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50	3.50	$175.00	$189.00
					$0.00		$0.00	0.00	$0.00	$0.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00	4.00	$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05	0.42	$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35	0.67	$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55	0.47	$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00	6.00	$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	4.00	$200.00	4.00	$200.00	$1,253.00

Subtotals:	$674,093.35		2573.75	$128,687.25	$867,055.60
Sales Tax:		$0.00			
			Overhead:	10%	$86,705.56
			Profit:	10%	$95,376.12
			Subtotal:		$1,049,137.28
			Bond:		$0.00
			Contingenc	15%	$157,370.59
			Grand Total:		$1,206,507.87

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-3
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	CONDENSER WTR SYS				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1500 GPM	1	EA	$2,693.00	$2,693.00	18.00	$900.00	18.00	$900.00	$3,593.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00	8.00	$400.00	$5,150.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50	31.98	$1,599.00	$3,669.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50	0.75	$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20	0.44	$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35	0.73	$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05	2.53	$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00	13.50	$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55	1.14	$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05	2.95	$147.35	$232.75
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15	505.20	$25,260.00	$42,260.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60	18.60	$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10	2.62	$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55	2.27	$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75	1.85	$92.25	$146.40
	CHEM FEED PUMP/TANK	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50	0.75	$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00	4.00	$200.00	$570.00
					$0.00		$0.00	0.00	$0.00	$0.00
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00	6.00	$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	5.00	$250.00	5.00	$250.00	$1,455.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
			Subtotals:		$32,788.15			626.80	$31,339.80	$66,127.95
			Sales Tax:		$0.00					

Overhead:	10%	$6,612.80
Profit:	10%	$6,612.80
Subtotal:		$79,353.54
Bond:		$0.00
Contingency:	15%	$11,903.03
Grand Total:		$91,256.57

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-3
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	TANK PUMPING SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	VERT TURBINE PUMPS				$0.00		$0.00	0.00	$0.00	$0.00
	2310 GPM	1	EA		$0.00	32.00	$1,600.00	32.00	$1,600.00	$1,600.00
	10" BUTTERFLY VALVES	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.50	0.33	$16.50	$95.50
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	FLEXIBLE CONNECTORS	1	EA	$340.00	$340.00	4.50	$225.00	4.50	$225.00	$565.00
	FLEXIBLE CONNECTOR	1	EA	$52.00	$52.00	0.50	$25.00	0.50	$25.00	$77.00
	2-WAY CONTROL VALVE	1	EA	$365.00	$365.00	0.75	$37.50	0.75	$37.50	$402.50
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	10" PIPING	150	LF	$73.00	$10,950.00	1.50	$75.00	225.00	$11,250.00	$22,200.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	10" INSULATION	150	LF	$2.60	$390.00	0.18	$8.90	26.70	$1,335.00	$1,725.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	PROJ MAN/ MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$25,100.00
					$0.00		$0.00	0.00	$0.00	$0.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$90,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:	$14,983.60		332.25	$16,612.65	$160,696.25
Sales Tax:		$0.00			
		Overhead:		10%	$16,069.63
		Profit:		10%	$16,069.63
		Subtotal:			$192,835.50
		Bond:			$0.00
		Contingency:		15%	$28,925.33
		Grand Total:			$221,760.83

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IH-3
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #4, cu. wir	180	L.F.	$1.00	$183.90	0.04	$1.30	7.20	$234.34	$418.24
3	Cable Termination	12	EA	$60.00	$732.96	0.93	$30.11	11.10	$361.27	$1,094.23
4	Grounding	1	EA	$200.00	$203.60	1.85	$60.05	1.85	$60.05	$263.65
5	1 1/2" emt Conduit	40	L.F.	$1.43	$58.23	0.09	$2.90	3.56	$115.87	$174.10
6	1 1/2" emt Connector	6	EA	$0.61	$3.73	0.07	$2.18	0.40	$13.08	$16.81
7	1 1/2" Conduit Hanger	4	EA	$1.25	$5.09	0.05	$1.72	0.21	$6.90	$11.99
8	1 1/2" Flex Conduit	5	L.F.	$0.31	$1.58	0.04	$1.30	0.20	$6.51	$8.09
9	1 1/2" Flex Connector	2	EA	$1.00	$2.04	0.10	$3.25	0.20	$6.51	$8.55
10	5kv Fuse	3	EA	$240.00	$732.96	0.40	$13.02	1.20	$39.06	$772.02
11	Connection to Equipment	1	EA	$40.00	$40.72	8.00	$260.38	8.00	$260.38	$301.10
					$0.00		$0.00	0.00	$0.00	$0.00
	Cooling Tower Fan-40hp				$0.00		$0.00	0.00	$0.00	$0.00
12	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
13	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
14	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
15	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
16	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
17	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
18	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
19	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
20	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
21	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
22	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
23	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
24	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
25	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
26	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
27	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Surge Tank Pump-30hp				$0.00		$0.00	0.00	$0.00	$0.00
28	#2 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
29	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
30	120amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
31	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
32	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
33	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
34	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
35	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-20hp				$0.00		$0.00	0.00	$0.00	$0.00
36	#3 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
37	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
38	80amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
39	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
40	Combo. Starter/Disc.	1	EA	$852.65	$868.00	7.01	$228.00	7.01	$228.00	$1,096.00
41	1 1/4" Flex Conduit	5	L.F.	$1.05	$5.34	0.11	$3.71	0.57	$18.55	$23.90
42	1 1/4" Flex Connector	2	EA	$6.25	$12.73	0.20	$6.51	0.40	$13.02	$25.74
43	100amp switch in Panel	1	EA	$525.45	$534.91	2.00	$65.09	2.00	$65.09	$600.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$11,486.46			214.45	$6,979.65	$18,466.10

Sales Tax:	0%	$0.00

Overhead:	10%	$1,846.61
Profit:	10%	$2,031.27
Subtotal:		$22,343.98
Bond:	0%	$0.00
Contingency:	10%	$2,234.40
Grand Total:		$24,578.38

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-4
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE HARVESTOR	485	TONS	$1,250.00	$606,250.00	3.50	$175.00	1697.50	$84,875.00	$691,125.00
	CLG TWR-975 TONS	1	EA	$18,500.00	$18,500.00	110.00	$5,500.00	110.00	$5,500.00	$24,000.00
	HOISTING				$0.00		$0.00	0.00	$0.00	$8,000.00
	TANK	1	EA		$0.00		$0.00	0.00	$0.00	$97,825.00
	PLATE HEAT EXCHNGR	1	EA	$23,523.00	$23,523.00	100.00	$5,000.00	100.00	$5,000.00	$28,523.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CHILLED WTR SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00	18.00	$900.00	$4,703.00
					$0.00		$0.00	0.00	$0.00	$0.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50	31.98	$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65	0.33	$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00	8.00	$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00	8.00	$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15	505.20	$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90	11.80	$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40	5.40	$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00	64.00	$3,200.00	$4,092.00
	2" INSULATION	50	LF	$0.80	$40.00	0.08	$4.00	4.00	$200.00	$240.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50	3.50	$175.00	$189.00
					$0.00		$0.00	0.00	$0.00	$0.00
	150 GAL EXP TANK	1	EA		$0.00	4.00	$200.00	4.00	$200.00	$200.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05	0.42	$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35	0.67	$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55	0.47	$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00	8.00	$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	6.00	$300.00	6.00	$300.00	$1,353.00
	Subtotals:				$679,474.35			2593.75	$129,687.25	$916,986.60
	Sales Tax:				$0.00					

Overhead:	10%	$91,698.66
Profit:	10%	$100,868.53
Subtotal:		$1,109,553.79
Bond:		$0.00
Contingency:	15%	$166,433.07
Grand Total:		$1,275,986.85

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-4
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	**DESCRIPTION**	**QTY.**	**UNIT**	**COST/UNIT**	**TOTAL**	**HRS/UNIT**	**COST/UNIT**	**TOTAL HRS**	**TOTAL COST**	**TOTAL**
					$0.00		$0.00	0.00	$0.00	$0.00
	CONDENSER WTR SYS				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 2340 GPM	1	EA	$5,943.00	$5,943.00	24.00	$1,200.00	24.00	$1,200.00	$7,143.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00	8.00	$400.00	$5,150.00
	10" BUTTERFLY VALVES	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50	0.75	$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20	0.44	$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35	0.73	$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05	2.53	$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00	13.50	$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55	1.14	$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05	2.95	$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00	600.00	$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60	18.60	$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10	2.62	$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55	2.27	$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75	1.85	$92.25	$146.40
	CHEM FEED PUMP/TANK	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50	0.75	$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00	4.00	$200.00	$570.00
					$0.00		$0.00	0.00	$0.00	$0.00
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00	8.00	$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$2,093.00	$2,093.00	8.00	$400.00	8.00	$400.00	$2,493.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:		$50,476.15	736.62	$36,830.80	$89,306.95
Sales Tax:		$0.00			

Overhead:	10%	$8,930.70
Profit:	10%	$8,930.70
Subtotal:		$107,168.34
Bond:		$0.00
Contingency:	15%	$16,075.25
Grand Total:		$123,243.59

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-4
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	TANK PUMPING SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	VERT TURBINE PUMPS				$0.00		$0.00	0.00	$0.00	$0.00
	3600 GPM	1	EA	$13,835.00	$13,835.00	60.00	$3,000.00	60.00	$3,000.00	$16,835.00
	12" BUTTERFLY VALVES	6	EA	$595.00	$3,570.00	8.00	$400.00	48.00	$2,400.00	$5,970.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.50	0.33	$16.50	$95.50
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	FLEXIBLE CONNECTORS	1	EA	$340.00	$340.00	4.50	$225.00	4.50	$225.00	$565.00
	FLEXIBLE CONNECTORS	1	EA	$52.00	$52.00	0.50	$25.00	0.50	$25.00	$77.00
	2-WAY CONTROL VALVE	1	EA	$365.00	$365.00	0.75	$37.50	0.75	$37.50	$402.50
					$0.00		$0.00	0.00	$0.00	$0.00
	12" PIPING	200	LF	$94.00	$18,800.00	1.71	$85.70	342.80	$17,140.00	$35,940.00
	10" PIPING	200	LF	$73.00	$14,600.00	1.50	$75.00	300.00	$15,000.00	$29,600.00
					$0.00		$0.00	0.00	$0.00	$0.00
	12" INSULATION	200	LF	$2.96	$592.00	0.20	$10.00	40.00	$2,000.00	$2,592.00
	10" INSULATION	200	LF	$2.60	$520.00	0.18	$8.90	35.60	$1,780.00	$2,300.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	PROJ MAN. /MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$29,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$96,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:		$53,010.60	838.95	$41,947.65	$233,958.25
Sales Tax:		$0.00			

Overhead:	10%	$23,395.83
Profit:	10%	$23,395.83
Subtotal:		$280,749.90
Bond:		$0.00
Contingency:	15%	$42,112.49
Grand Total:		$322,862.39

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-25hp				$0.00		$0.00	0.00	$0.00	$0.00
37	#4 thwn cu. conductor	180	L.F.	$0.39	$71.46	0.02	$0.65	3.60	$117.17	$188.63
38	1 1/4" EMT conduit	50	L.F.	$1.21	$61.59	0.08	$2.60	4.00	$130.19	$191.78
39	90amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
40	Connection to Equipment	1	EA	$30.00	$30.54	4.09	$133.17	4.09	$133.17	$163.71
41	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
42	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.58	0.55	$17.90	$23.35
43	1 1/4" Flex Connector	2	EA	$6.38	$12.99	0.20	$6.51	0.40	$13.02	$26.01
44	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:		$14,906.20
Sales Tax:	0%	$0.00

Subtotals:	324.24	$10,552.91	$25,459.11
Overhead:		10%	$2,545.91
Profit:		10%	$2,800.50
Subtotal:			$30,805.52
Bond:		0%	$0.00
Contingency:		10%	$3,080.55
Grand Total:			$33,886.07

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IH-4
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
13	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
14	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
15	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
16	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
17	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
18	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
19	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
20	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Surge Tank Pump-50hp				$0.00		$0.00	0.00	$0.00	$0.00
21	#1 thwn cu. conductor	150	L.F.	$1.60	$244.32	0.12	$3.75	17.27	$561.99	$806.31
22	1 1/2" EMT conduit	40	L.F.	$1.90	$77.37	0.18	$5.86	7.20	$234.34	$311.71
23	175amp fuse	3	EA	$21.00	$64.13	0.60	$19.53	1.80	$58.58	$122.72
24	Connection to Equipment	1	EA	$160.50	$163.39	12.00	$390.56	12.00	$390.56	$553.95
25	Combo. Starter/Disc.	1	EA	$1,400.00	$1,425.20	11.00	$358.02	11.00	$358.02	$1,783.22
26	1 1/2" Flex Conduit	5	L.F.	$1.80	$9.16	0.54	$17.58	2.70	$87.88	$97.04
27	1 1/2" Flex Connector	2	EA	$9.50	$19.34	0.42	$13.67	0.84	$27.34	$46.68
28	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38
					$0.00		$0.00	0.00	$0.00	$0.00
	Cooling Tower Fan-60hp				$0.00		$0.00	0.00	$0.00	$0.00
29	#2/0 thwn cu. conductor	150	L.F.	$1.17	$178.66	0.03	$0.98	4.50	$146.46	$325.12
30	2" EMT conduit	40	L.F.	$1.91	$77.78	0.10	$3.25	4.00	$130.19	$207.96
31	200amp fuse	3	EA	$22.50	$68.72	0.22	$7.23	0.67	$21.68	$90.39
32	Connection to Equipment	1	EA	$300.00	$305.40	20.00	$650.94	20.00	$650.94	$956.34
33	Combo. Starter/Disc.	1	EA	$1,943.67	$1,978.66	16.00	$520.75	16.00	$520.75	$2,499.41
34	2" Flex Conduit	5	L.F.	$1.80	$9.16	0.20	$6.51	1.00	$32.55	$41.71
35	2" Flex Connector	2	EA	$12.30	$25.04	0.35	$11.33	0.70	$22.65	$47.70
36	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-25hp				$0.00		$0.00	0.00	$0.00	$0.00
37	#4 thwn cu. conductor	180	L.F.	$0.39	$71.46	0.02	$0.65	3.60	$117.17	$188.63
38	1 1/4" EMT conduit	50	L.F.	$1.21	$61.59	0.08	$2.60	4.00	$130.19	$191.78
39	90amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
40	Connection to Equipment	1	EA	$30.00	$30.54	4.09	$133.17	4.09	$133.17	$163.71
41	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
42	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.58	0.55	$17.90	$23.35
43	1 1/4" Flex Connector	2	EA	$6.38	$12.99	0.20	$6.51	0.40	$13.02	$26.01
44	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
				Subtotals:	$14,906.20			324.24	$10,552.91	$25,459.11
			Sales Tax:	0%	$0.00					

Overhead:	10%	$2,545.91
Profit:	10%	$2,800.50
Subtotal:		$30,805.52
Bond:	0%	$0.00
Contingency:	10%	$3,080.55
Grand Total:		$33,886.07

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-5
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE HARVESTOR	485	TONS	$1,250.00	$606,250.00	3.50	$175.00	1697.50	$84,875.00	$691,125.00
	CLG TWR-820 TONS	1	EA	$14,500.00	$14,500.00	110.00	$5,500.00	110.00	$5,500.00	$20,000.00
	HOISTING	1	LS		$0.00		$0.00	0.00	$0.00	$8,000.00
	TANK	1	EA		$0.00		$0.00	0.00	$0.00	$49,725.00
	PLATE HEAT EXCHNGR	1	EA	$18,500.00	$18,500.00	100.00	$5,000.00	100.00	$5,000.00	$23,500.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CHILLED WTR SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00	18.00	$900.00	$4,703.00
					$0.00		$0.00	0.00	$0.00	$0.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50	31.98	$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65	0.33	$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00	8.00	$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00	8.00	$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS		$0.00		$0.00	0.00	$0.00	$2,000.00
	8" PIPING	400	LF	$56.00	$22,400.00	1.26	$63.15	505.20	$25,260.00	$47,660.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90	11.80	$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40	5.40	$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00	64.00	$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00	8.00	$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50	3.50	$175.00	$189.00
					$0.00		$0.00	0.00	$0.00	$0.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00	4.00	$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05	0.42	$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35	0.67	$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55	0.47	$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00	8.00	$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	6.00	$300.00	6.00	$300.00	$1,353.00
	Subtotals:				$676,736.35			2597.75	$129,887.25	$866,348.60
	Sales Tax:				$0.00					

Overhead:	10%	$86,634.86
Profit:	10%	$95,298.35
Subtotal:		$1,048,281.81
Bond:		$0.00
Contingency:	15%	$157,242.27
Grand Total:		$1,205,524.08

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-5
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	CONDENSER WTR SYS				$0.00		$0.00	0.00	$0.00	$0.00
	PUMPS 1970 GPM	1	EA	$5,773.00	$5,773.00	24.00	$1,200.00	24.00	$1,200.00	$6,973.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00	8.00	$400.00	$5,150.00
	10" BUTTERFLY VALVES	6	EA	$425.00	$2,550.00	6.00	$300.00	36.00	$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50	0.75	$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20	0.44	$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35	0.73	$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05	2.53	$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00	13.50	$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55	1.14	$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05	2.95	$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00	600.00	$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60	18.60	$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10	2.62	$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55	2.27	$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75	1.85	$92.25	$146.40
	CHEM FEED PUMP/TANK	1	EA		$0.00		$0.00	0.00	$0.00	$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50	0.75	$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00	4.00	$200.00	$570.00
					$0.00		$0.00	0.00	$0.00	$0.00
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00	8.00	$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$2,093.00	$2,093.00	6.00	$300.00	6.00	$300.00	$2,393.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
				Subtotals:	$50,306.15			734.62	$36,730.80	$89,036.95
			Sales Tax:		$0.00					

Overhead:	10%	$8,903.70
Profit:	10%	$8,903.70
Subtotal:		$106,844.34
Bond:		$0.00
Contingency:	15%	$16,026.65
Grand Total:		$122,870.99

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IH-5
Date:	April 05, 1995
Prepared By:	MELISSA RUSSO
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
					$0.00		$0.00	0.00	$0.00	$0.00
	TANK PUMPING SYSTEM				$0.00		$0.00	0.00	$0.00	$0.00
	VERT TURBINE PUMPS				$0.00		$0.00	0.00	$0.00	$0.00
	3025 GPM		EA	$9,740.00	$0.00	60.00	$3,000.00	0.00	$0.00	$0.00
	12" BUTTERFLY VALVES	6	EA	$595.00	$3,570.00	8.00	$400.00	48.00	$2,400.00	$5,970.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50	0.50	$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50	0.50	$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.50	0.33	$16.50	$95.50
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05	3.37	$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05	2.11	$105.25	$166.25
	FLEXIBLE CONNECTORS	1	EA	$340.00	$340.00	4.50	$225.00	4.50	$225.00	$565.00
	FLEXIBLE CONNECTORS	1	EA	$52.00	$52.00	0.50	$25.00	0.50	$25.00	$77.00
	2-WAY CONTROL VALV	1	EA	$365.00	$365.00	0.75	$37.50	0.75	$37.50	$402.50
					$0.00		$0.00	0.00	$0.00	$0.00
	12" PIPING	200	LF	$94.00	$18,800.00	1.71	$85.70	342.80	$17,140.00	$35,940.00
	10" PIPING	200	LF	$73.00	$14,600.00	1.50	$75.00	300.00	$15,000.00	$29,600.00
					$0.00		$0.00	0.00	$0.00	$0.00
	12" INSULATION	200	LF	$2.96	$592.00	0.20	$10.00	40.00	$2,000.00	$2,592.00
	10" INSULATION	200	LF	$2.60	$520.00	0.18	$8.90	35.60	$1,780.00	$2,300.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	PROJ MAN/ MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$29,500.00
					$0.00		$0.00	0.00	$0.00	$0.00
	SEISMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$96,750.00
					$0.00		$0.00	0.00	$0.00	$0.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$39,175.60			778.95	$38,947.65	$218,373.25
	Sales Tax:				$0.00					

Overhead:	10%	$21,837.33
Profit:	10%	$21,837.33
Subtotal:		$262,047.90
Bond:		$0.00
Contingency:	15%	$39,307.19
Grand Total:		$301,355.09

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IH-5
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
13	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
14	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
15	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
16	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
17	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
18	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
19	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
20	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Surge Tank Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
21	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
22	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
23	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
24	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
25	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
26	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
27	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
28	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Cooling Tower Fan-60hp				$0.00		$0.00	0.00	$0.00	$0.00
29	#2/0 thwn cu. conductor	150	L.F.	$1.17	$178.66	0.03	$0.98	4.50	$146.46	$325.12
30	2" EMT conduit	40	L.F.	$1.91	$77.78	0.10	$3.25	4.00	$130.19	$207.96
31	200amp fuse	3	EA	$22.50	$68.72	0.22	$7.23	0.67	$21.68	$90.39
32	Connection to Equipment	1	EA	$300.00	$305.40	20.00	$650.94	20.00	$650.94	$956.34
33	Combo. Starter/Disc.	1	EA	$1,943.67	$1,978.66	16.00	$520.75	16.00	$520.75	$2,499.41
34	2" Flex Conduit	5	L.F.	$1.80	$9.16	0.20	$6.51	1.00	$32.55	$41.71
35	2" Flex Connector	2	EA	$12.30	$25.04	0.35	$11.33	0.70	$22.65	$47.70
36	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cond. Water Pump-20hp				$0.00		$0.00	0.00	$0.00	$0.00
37	#3 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
38	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
39	80amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
40	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
41	Combo. Starter/Disc.	1	EA	$852.65	$868.00	7.01	$228.00	7.01	$228.00	$1,096.00
42	1 1/4" Flex Conduit	5	L.F.	$1.05	$5.34	0.11	$3.71	0.57	$18.55	$23.90
43	1 1/4" Flex Connector	2	EA	$6.25	$12.73	0.20	$6.51	0.40	$13.02	$25.74
44	100amp switch in Panel	1	EA	$525.45	$534.91	2.00	$65.09	2.00	$65.09	$600.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$13,631.71			282.73	$9,202.11	$22,833.82

Sales Tax:	0%	$0.00	Overhead:	10%	$2,283.38
			Profit:	10%	$2,511.72
			Subtotal:		$27,628.92
			Bond:	0%	$0.00
			Contingency:	10%	$2,762.89
			Grand Total:		$30,391.81

ICE TANK SYSTEM

COST ESTIMATES

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-1
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE TANKS	3300	TONS-HRS	$44.00	$145,200.00					$145,200.00
	CLG TWR-890 TONS	890	TON	$40.00	$35,600.00	100.00	$6.25		$5,562.50	$41,162.50
	HOISTING	1	LS							$8,000.00
	ICE MACHINE 400 TONS	400	TON	$375.00	$150,000.00	100.00	$105.00		$42,000.00	$192,000.00
	NIGHT CHILLER 400 TO	400	TON	$180.00	$72,000.00	100.00	$105.00		$42,000.00	$114,000.00
	CHILLED WTR SYSTEM									
	PUMP 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00		$900.00	$4,703.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50		$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65		$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05		$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05		$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00		$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00		$400.00	$864.00
	CHEMICAL POT FEEDER	1	ls							$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15		$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90		$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40		$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00		$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00		$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50		$175.00	$189.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00		$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05		$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35		$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55		$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00		$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	5.00	$250.00		$250.00	$1,455.00

Subtotals:		$434,168.35
Sales Tax:		$0.00

		$123,924.75	$568,093.10
Overhead:		10%	$56,809.31
Profit:		10%	$62,490.24
Subtotal:			$687,392.65
Bond:			$0.00
Contingenc		15%	$103,108.90
Grand Total:			$790,501.55

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-1
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	CONDENSER WTR SYS									
	PUMPS 2160 GPM	1	EA	$5,943.00	$5,943.00	18.00	$1,200.00		$1,200.00	$7,143.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00		$400.00	$5,150.00
	10" BUTTERFLY VALVE	6	EA	$425.00	$2,550.00	6.00	$300.00		$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50		$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20		$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35		$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05		$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00		$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55		$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05		$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00		$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60		$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10		$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55		$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75		$92.25	$146.40
	CHEM FEED PUMP/TAN	1	LS							$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50		$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00		$200.00	$570.00
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	8.00	$400.00		$400.00	$1,738.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	6.00	$300.00		$300.00	$1,505.00

Subtotals:	$48,718.15		$36,730.80 / $87,448.95
Sales Tax:	$0.00		

Overhead:	10%	$8,744.90
Profit:	10%	$8,744.90
Subtotal:		$104,938.74
Bond:		$0.00
Contingency:	15%	$15,740.81
Grand Total:		$120,679.55

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-1
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	PROJ MAN/MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$39,900.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$90,000.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00

Subtotals:	$0.00	0.00	$0.00	$143,900.00
Sales Tax:	$0.00			

Overhead:	10%	$14,390.00
Profit:	10%	$14,390.00
Subtotal:		$172,680.00
Bond:		$0.00
Contingency:	15%	$25,902.00
Grand Total:		$198,582.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IT-1
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller #1 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chiller #2 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
13	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
14	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
15	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
16	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
17	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
18	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
19	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
20	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
21	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
22	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
23	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
24	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
25	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
26	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
27	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
28	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
29	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
30	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
31	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
32	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cooling Tower Fan-60hp				$0.00		$0.00	0.00	$0.00	$0.00
33	#2/0 thwn cu. conductor	150	L.F.	$1.17	$178.66	0.03	$0.98	4.50	$146.46	$325.12
34	2" EMT conduit	40	L.F.	$1.91	$77.78	0.10	$3.25	4.00	$130.19	$207.96
35	200amp fuse	3	EA	$22.50	$68.72	0.22	$7.23	0.67	$21.68	$90.39
36	Connection to Equipment	1	EA	$300.00	$305.40	20.00	$650.94	20.00	$650.94	$956.34
37	Combo. Starter/Disc.	1	EA	$1,943.67	$1,978.66	16.00	$520.75	16.00	$520.75	$2,499.41
38	2" Flex Conduit	5	L.F.	$1.80	$9.16	0.20	$6.51	1.00	$32.55	$41.71
39	2" Flex Connector	2	EA	$12.30	$25.04	0.35	$11.33	0.70	$22.65	$47.70
40	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38
					$0.00		$0.00	0.00	$0.00	$0.00
	Cond. Water Pump-20hp				$0.00		$0.00	0.00	$0.00	$0.00
36	#3 thwn cu. conductor	150	L.F.	$0.55	$83.83	0.02	$0.65	3.00	$97.64	$181.47
37	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
38	80amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
39	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
40	Combo. Starter/Disc.	1	EA	$852.65	$868.00	7.01	$228.00	7.01	$228.00	$1,096.00
41	1 1/4" Flex Conduit	5	L.F.	$1.05	$5.34	0.11	$3.71	0.57	$18.55	$23.90
42	1 1/4" Flex Connector	2	EA	$6.25	$12.73	0.20	$6.51	0.40	$13.02	$25.74
43	100amp switch in Panel	1	EA	$525.45	$534.91	2.00	$65.09	2.00	$65.09	$600.00
					$0.00		$0.00	0.00	$0.00	$0.00
44	New 1500kva Trans.	1	EA	$19,902.0	$20,260.24	118.04	$3,841.78	118.04	$3,841.78	$24,102.01
					$0.00		$0.00	0.00	$0.00	$0.00
45	Disposal of existing trans.	1	EA	$2,946.95	$3,000.00	30.72	$1,000.00	30.72	$1,000.00	$3,999.99
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:	$37,247.02	565.48	$18,404.71	$55,651.73
Sales Tax:	0%	$0.00		

Overhead:	10%	$5,565.17
Profit:	10%	$6,121.69
Subtotal:		$67,338.59
Bond:	0%	$0.00
Contingency:	10%	$6,733.86
Grand Total:		$74,072.45

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-2
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	OST/UNI	TOTAL HRS	TOTAL COST	TOTAL
	ICE HARVESTOR	4000	TONS-HRS	$44.00	$176,000.00					$176,000.00
	CLG TWR (900 TONS)	900	EA	$40.00	$36,000.00	120.00	$6.25		$5,625.00	$41,625.00
	HOISTING	1	LS							$8,000.00
	ICE MACHINE 450 TONS	450	TON	$375.00	$168,750.00	100.00	$105.00		$47,250.00	$216,000.00
	NIGHT CHILLER 450 TO	450	TON	$180.00	$81,000.00	100.00	$105.00		$47,250.00	$128,250.00
	CHILLED WTR SYSTEM									
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00		$900.00	$4,703.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50		$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65		$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05		$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05		$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00		$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00		$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS							$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15		$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90		$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40		$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00		$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00		$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50		$175.00	$189.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00		$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05		$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35		$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55		$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	8.00	$400.00		$400.00	$1,738.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	6.00	$300.00		$300.00	$1,505.00
	Subtotals:				$493,118.35			0.00	$134,637.25	$637,755.60
	Sales Tax:				$0.00					

Overhead:	10%	$63,775.56
Profit:	10%	$70,153.12
Subtotal:		$771,684.28
Bond:		$0.00
Contingen	15%	$115,752.64
Grand Total:		$887,436.92

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-2
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	CONDENSER WTR SYS									
	PUMPS 2160 GPM	1	EA	$5,943.00	$5,943.00	24.00	$1,200.00		$1,200.00	$7,143.00
	GRISWOLD SEPARATOR	1	EA	$5,850.00	$5,850.00	8.00	$400.00		$400.00	$6,250.00
	10" BUTTERFLY VALVE	6	EA	$425.00	$2,550.00	6.00	$300.00		$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50		$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20		$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35		$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05		$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00		$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55		$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05		$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00		$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60		$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10		$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55		$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75		$92.25	$146.40
	CHEM FEED PUMP/TAN	1	LS							$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50		$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00		$200.00	$570.00
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00		$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	5.00	$250.00		$250.00	$1,455.00

Subtotals:	$49,818.15		$36,580.80	$88,398.95
Sales Tax:	$0.00			
		Overhead:	10%	$8,839.90
		Profit:	10%	$8,839.90
		Subtotal:		$106,078.74
		Bond:		$0.00
		Contingency:	15%	$15,911.81
		Grand Total:		$121,990.55

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-2
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	PROJ MAN/MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$39,900.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$90,000.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00

Subtotals:		$0.00	0.00	$0.00	$143,900.00
Sales Tax:		$0.00			
			Overhead:	10%	$14,390.00
			Profit:	10%	$14,390.00
			Subtotal:		$172,680.00
			Bond:		$0.00
			Contingency:	15%	$25,902.00
			Grand Total:		$198,582.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IT-2
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller #1 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shld., 5kv, #3/0, cu. wire	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chiller #2 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
13	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
14	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
15	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
16	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
17	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
18	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
19	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
20	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
21	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
22	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
23	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
24	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
25	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
26	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
27	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
28	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
29	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
30	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
31	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
32	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cooling Tower Fan-60hp				$0.00		$0.00	0.00	$0.00	$0.00
33	#2/0 thwn cu. conductor	150	L.F.	$1.17	$178.66	0.03	$0.98	4.50	$146.46	$325.12
34	2" EMT conduit	40	L.F.	$1.91	$77.78	0.10	$3.25	4.00	$130.19	$207.96
35	200amp fuse	3	EA	$22.50	$68.72	0.22	$7.23	0.67	$21.68	$90.39
36	Connection to Equipment	1	EA	$300.00	$305.40	20.00	$650.94	20.00	$650.94	$956.34
37	Combo. Starter/Disc.	1	EA	$1,943.67	$1,978.66	16.00	$520.75	16.00	$520.75	$2,499.41
38	2" Flex Conduit	5	L.F.	$1.80	$9.16	0.20	$6.51	1.00	$32.55	$41.71
39	2" Flex Connector	2	EA	$12.30	$25.04	0.35	$11.33	0.70	$22.65	$47.70
40	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38
					$0.00		$0.00	0.00	$0.00	$0.00
	Cond. Water Pump-25hp				$0.00		$0.00	0.00	$0.00	$0.00
41	#4 thwn cu. conductor	180	L.F.	$0.39	$71.46	0.02	$0.65	3.60	$117.17	$188.63
42	1 1/4" EMT conduit	50	L.F.	$1.21	$61.59	0.08	$2.60	4.00	$130.19	$191.78
43	90amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
44	Connection to Equipment	1	EA	$30.00	$30.54	4.09	$133.17	4.09	$133.17	$163.71
45	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
46	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.58	0.55	$17.90	$23.35
47	1 1/4" Flex Connector	2	EA	$6.38	$12.99	0.20	$6.51	0.40	$13.02	$26.01
48	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
49	New 1500kva Transforme	1	EA	$19,902.0	$20,260.24	118.04	$3,841.78	118.04	$3,841.78	$24,102.01
					$0.00		$0.00	0.00	$0.00	$0.00
50	Disposal of existing trans.	1	EA	$2,946.95	$3,000.00	30.72	$1,000.00	30.72	$1,000.00	$3,999.99
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$38,170.52			570.55	$18,569.60	$56,740.12
	Sales Tax:			0%	$0.00					

Overhead:	10%	$5,674.01
Profit:	10%	$6,241.41
Subtotal:		$68,655.55
Bond:	0%	$0.00
Contingency:	10%	$6,865.55
Grand Total:		$75,521.10

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-3
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE TANK	6000	TONS-HRS	$44.00	$264,000.00					$264,000.00
	CLG TWR-1215 TONS	1215	EA	$40.00	$48,600.00	110.00	$5.00		$6,075.00	$54,675.00
	HOISTING	1	LS							$8,000.00
	ICE MACHINE 815 TONS	815	TON	$375.00	$305,625.00	100.00	$80.00		$65,200.00	$370,825.00
	NIGHT CHILLER 400 TO	400	TON	$180.00	$72,000.00	100.00	$100.00		$40,000.00	$112,000.00
	CHILLED WTR SYSTEM									
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00		$900.00	$4,703.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50		$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65		$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05		$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05		$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00		$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00		$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS							$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15		$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90		$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40		$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00		$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00		$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50		$175.00	$189.00
					$0.00					
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00		$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05		$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35		$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55		$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00		$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	4.00	$200.00		$200.00	$1,253.00
	Subtotals:				$721,441.35				$145,587.25	$877,028.60
	Sales Tax:				$0.00					

Overhead:	10%	$87,702.86
Profit:	10%	$96,473.15
Subtotal:		$1,061,204.61
Bond:		$0.00
Contingen	15%	$159,180.69
Grand Total:		$1,220,385.30

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATE IT-3
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	CONDENSER WTR SYS									
	PUMPS 2916 GPM	1	EA	$5,943.00	$5,943.00	18.00	$1,200.00		$1,200.00	$7,143.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00		$400.00	$5,150.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50		$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20		$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35		$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05		$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00		$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55		$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05		$147.35	$232.75
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15		$25,260.00	$42,260.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60		$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10		$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55		$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75		$92.25	$146.40
	CHEM FEED PUMP/TAN	1	LS							$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50		$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00		$200.00	$570.00
	TRIPLE DUTY VALVE	1	EA	$1,338.00	$1,338.00	6.00	$300.00		$300.00	$1,638.00
	SUCTION DIFFUSER	1	EA	$1,205.00	$1,205.00	5.00	$250.00		$250.00	$1,455.00

Subtotals:	$36,038.15	$31,639.80	$69,677.95
Sales Tax:	$0.00		
Overhead:		10%	$6,967.80
Profit:		10%	$6,967.80
Subtotal:			$83,613.54
Bond:			$0.00
Contingency:		15%	$12,542.03
Grand Total:			$96,155.57

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-3
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	PROJ MAN. /MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$29,000.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$120,000.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
	Subtotals:				$0.00			0.00	$0.00	$163,000.00
	Sales Tax:				$0.00					

Overhead:	10%	$16,300.00
Profit:	10%	$16,300.00
Subtotal:		$195,600.00
Bond:		$0.00
Contingency:	15%	$29,340.00
Grand Total:		$224,940.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IT-3
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller #1 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #4/0, cu. w	180	L.F.	$3.10	$568.04	0.15	$4.88	27.00	$878.77	$1,446.81
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	EA	$500.00	$509.00	20.00	$650.94	20.00	$650.94	$1,159.94
					$0.00		$0.00	0.00	$0.00	$0.00
	Chiller #2 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
13	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
14	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
15	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
16	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
17	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
18	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
19	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
20	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
21	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
22	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
23	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
24	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
25	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
26	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
27	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
28	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
29	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
30	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
31	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
32	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
33	New 1500kva Transforme	1	EA	$19,902.0	$20,260.24	118.04	$3,841.78	118.04	$3,841.78	$24,102.01
					$0.00		$0.00	0.00	$0.00	$0.00
34	Disposal of existing trans.	1	EA	$2,946.95	$3,000.00	30.72	$1,000.00	30.72	$1,000.00	$3,999.99
					$0.00		$0.00	0.00	$0.00	$0.00
35	New Primary for Trans.	1	LOT	n/a	$0.00	460.87	$15,000.00	460.87	$15,000.00	$15,000.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	(2) Cond. Water P.-20hp				$0.00		$0.00	0.00	$0.00	$0.00
36	#3 thwn cu. conductor	300	L.F.	$0.55	$167.66	0.02	$0.65	6.00	$195.28	$362.95
37	1 1/4" EMT conduit	80	L.F.	$1.21	$98.54	0.08	$2.60	6.40	$208.30	$306.84
38	80amp fuse	6	EA	$10.15	$62.00	0.20	$6.51	1.20	$39.06	$101.05
39	Connection to Equipment	2	EA	$20.00	$40.72	4.00	$130.19	8.00	$260.38	$301.10
40	Combo. Starter/Disc.	2	EA	$852.65	$1,736.00	7.01	$228.00	14.01	$456.00	$2,191.99
41	1 1/4" Flex Conduit	10	L.F.	$1.05	$10.69	0.11	$3.71	1.14	$37.10	$47.79
42	1 1/4" Flex Connector	4	EA	$6.25	$25.45	0.20	$6.51	0.80	$26.04	$51.49
43	100amp switch in Panel	2	EA	$525.45	$1,069.82	2.00	$65.09	4.00	$130.19	$1,200.00
					$0.00		$0.00	0.00	$0.00	$0.00
	(2) Cooling Twr. Fan-30hp				$0.00		$0.00	0.00	$0.00	$0.00
44	#2 thwn cu. conductor	300	L.F.	$0.55	$167.66	0.02	$0.65	6.00	$195.28	$362.95
45	1 1/4" EMT conduit	80	L.F.	$1.21	$98.54	0.08	$2.60	6.40	$208.30	$306.84
46	120amp fuse	6	EA	$29.00	$177.13	0.20	$6.51	1.20	$39.06	$216.19
47	Connection to Equipment	2	EA	$20.00	$40.72	4.00	$130.19	8.00	$260.38	$301.10
48	Combo. Starter/Disc.	2	EA	$1,356.58	$2,762.00	10.60	$345.00	21.20	$690.00	$3,451.99
49	1 1/4" Flex Conduit	10	L.F.	$1.07	$10.89	0.11	$3.71	1.14	$37.10	$48.00
50	1 1/4" Flex Connector	4	EA	$6.38	$25.96	0.20	$6.51	0.80	$26.04	$52.00
51	100amp switch in Panel	2	EA	$918.38	$1,869.82	2.00	$65.09	4.00	$130.19	$2,000.01
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Subtotals:				$40,916.82			1072.12	$34,894.34	$75,811.15

Sales Tax:	0%	$0.00

Overhead:	10%	$7,581.12
Profit:	10%	$8,339.23
Subtotal:		$91,731.50
Bond:	0%	$0.00
Contingency:	10%	$9,173.15
Grand Total:		$100,904.65

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-4
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE TANK	6000	TONS-HRS	$44.00	$264,000.00					$264,000.00
	CLG TWR-1085 TONS	1085	TONS	$40.00	$43,400.00	0.13	$6.25		$6,781.25	$50,181.25
	HOISTING									$8,000.00
	ICE MACHINE 635 TONS	635	TON	$375.00	$238,125.00	100.00	$85.00		$53,975.00	$292,100.00
	NIGHT CHILLER 450 TO	450	TON	$180.00	$81,000.00	100.00	$115.00		$51,750.00	$132,750.00
	CHILLED WTR SYSTEM									
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00		$900.00	$4,703.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50		$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65		$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05		$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05		$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00		$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00		$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS							$2,000.00
	8" PIPING	400	LF	$42.50	$17,000.00	1.26	$63.15		$25,260.00	$42,260.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90		$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40		$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00		$3,200.00	$4,092.00
	2" INSULATION	50	LF	$0.80	$40.00	0.08	$4.00		$200.00	$240.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50		$175.00	$189.00
	150 GAL EXP TANK	1	EA			4.00	$200.00		$200.00	$200.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05		$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35		$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55		$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00		$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	6.00	$300.00		$300.00	$1,353.00
	Subtotals:				$657,726.35				$146,818.50	$814,544.85
	Sales Tax:				$0.00					

Overhead:	10%	$81,454.49
Profit:	10%	$89,599.93
Subtotal:		$985,599.27
Bond:		$0.00
Contingenc	15%	$147,839.89
Grand Total:		$1,133,439.16

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-4
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	CONDENSER WTR SYS									
	PUMPS 2600 GPM	1	EA	$5,943.00	$5,943.00	24.00	$1,200.00		$1,200.00	$7,143.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00		$400.00	$5,150.00
	10" BUTTERFLY VALVE	6	EA	$425.00	$2,550.00	6.00	$300.00		$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50		$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20		$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35		$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05		$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00		$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55		$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05		$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00		$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60		$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10		$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55		$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75		$92.25	$146.40
	CHEM FEED PUMP/TAN	1	LS							$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50		$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00		$200.00	$570.00
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00		$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$2,093.00	$2,093.00	8.00	$400.00		$400.00	$2,493.00

Subtotals:	$50,476.15	$36,830.80	$89,306.95
Sales Tax:	$0.00		
Overhead:		10%	$8,930.70
Profit:		10%	$8,930.70
Subtotal:			$107,168.34
Bond:			$0.00
Contingency:		15%	$16,075.25
Grand Total:			$123,243.59

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-4
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	PROJ MAN. /MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$29,000.00
	SIESMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$120,000.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00
	Subtotals:				$0.00			0.00	$0.00	$163,000.00
	Sales Tax:				$0.00					

Overhead:	10%	$16,300.00
Profit:	10%	$16,300.00
Subtotal:		$195,600.00
Bond:		$0.00
Contingency:	15%	$29,340.00
Grand Total:		$224,940.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IT-4
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller #1 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chiller #2 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
13	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
14	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
15	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
16	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
17	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
18	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
19	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
20	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
21	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
22	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
23	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
24	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
25	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
26	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
27	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
28	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
29	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
30	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
31	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
32	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
33	New 1000kva Transforme	1	EA	$15,000.0	$15,270.00	54.25	$1,765.67	54.25	$1,765.67	$17,035.67
					$0.00		$0.00	0.00	$0.00	$0.00
34	Disposal of existing trans.	1	EA	$2,946.95	$3,000.00	30.72	$1,000.00	30.72	$1,000.00	$3,999.99
					$0.00		$0.00	0.00	$0.00	$0.00
35	New Primary for Trans.	1	LOT	n/a	$0.00	460.87	$15,000.00	460.87	$15,000.00	$15,000.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	(2) Cond. Water P.-20hp				$0.00		$0.00	0.00	$0.00	$0.00
36	#3 thwn cu. conductor	300	L.F.	$0.55	$167.66	0.02	$0.65	6.00	$195.28	$362.95
37	1 1/4" EMT conduit	80	L.F.	$1.21	$98.54	0.08	$2.60	6.40	$208.30	$306.84
38	80amp fuse	6	EA	$10.15	$62.00	0.20	$6.51	1.20	$39.06	$101.05
39	Connection to Equipment	2	EA	$20.00	$40.72	4.00	$130.19	8.00	$260.38	$301.10
40	Combo. Starter/Disc.	2	EA	$852.65	$1,736.00	7.01	$228.00	14.01	$456.00	$2,191.99
41	1 1/4" Flex Conduit	10	L.F.	$1.05	$10.69	0.11	$3.71	1.14	$37.10	$47.79
42	1 1/4" Flex Connector	4	EA	$6.25	$25.45	0.20	$6.51	0.80	$26.04	$51.49
43	100amp switch in Panel	2	EA	$525.45	$1,069.82	2.00	$65.09	4.00	$130.19	$1,200.00
					$0.00		$0.00	0.00	$0.00	$0.00
	(2) Cooling Twr. Fan-30hp				$0.00		$0.00	0.00	$0.00	$0.00
44	#2 thwn cu. conductor	300	L.F.	$0.55	$167.66	0.02	$0.65	6.00	$195.28	$362.95
45	1 1/4" EMT conduit	80	L.F.	$1.21	$98.54	0.08	$2.60	6.40	$208.30	$306.84
46	120amp fuse	6	EA	$29.00	$177.13	0.20	$6.51	1.20	$39.06	$216.19
47	Connection to Equipment	2	EA	$20.00	$40.72	4.00	$130.19	8.00	$260.38	$301.10
48	Combo. Starter/Disc.	2	EA	$1,356.58	$2,762.00	10.60	$345.00	21.20	$690.00	$3,451.99
49	1 1/4" Flex Conduit	10	L.F.	$1.07	$10.89	0.11	$3.71	1.14	$37.10	$48.00
50	1 1/4" Flex Connector	4	EA	$6.38	$25.96	0.20	$6.51	0.80	$26.04	$52.00
51	100amp switch in Panel	2	EA	$918.38	$1,869.82	2.00	$65.09	4.00	$130.19	$2,000.01
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:		$35,353.54	977.22	$31,805.53	$67,159.07
Sales Tax:	0%	$0.00			

Overhead:	10%	$6,715.91
Profit:	10%	$7,387.50
Subtotal:		$81,262.47
Bond:	0%	$0.00
Contingency:	10%	$8,126.25
Grand Total:		$89,388.72

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-5
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 1
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	ICE TANK	4500	TONS-HRS	$44.00	$198,000.00					$198,000.00
	CLG TWR-970 TONS	970	TONS	$40.00	$38,800.00	0.13	$6.25		$6,062.50	$44,862.50
	HOISTING	1	LS							$8,000.00
	ICE MACHINE 520 TONS	520	TON	$375.00	$195,000.00	100.00	$100.00		$52,000.00	$247,000.00
	NIGHT CHILLER 450 TO	450	TON	$180.00	$81,000.00	100.00	$115.00		$51,750.00	$132,750.00
	CHILLED WTR SYSTEM									
	PUMPS 1440 GPM	1	EA	$3,803.00	$3,803.00	18.00	$900.00		$900.00	$4,703.00
	8" BUTTERFLY VALVES	6	EA	$345.00	$2,070.00	5.33	$266.50		$1,599.00	$3,669.00
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	PRESSURE GAGES	2	EA	$16.50	$33.00	0.25	$12.50		$25.00	$58.00
	RELIEF VALVES	1	EA	$79.00	$79.00	0.33	$16.65		$16.65	$95.65
	1" BALL VALVES	8	EA	$12.20	$97.60	0.42	$21.05		$168.40	$266.00
	GAGE COCKS	5	EA	$12.20	$61.00	0.42	$21.05		$105.25	$166.25
	8" AIR SEPARATOR	1	EA	$2,525.00	$2,525.00	8.00	$400.00		$400.00	$2,925.00
	FLEXIBLE CONNECTOR	2	EA	$232.00	$464.00	4.00	$200.00		$400.00	$864.00
	CHEMICAL POT FEEDER	1	LS							$2,000.00
	8" PIPING	400	LF	$56.00	$22,400.00	1.26	$63.15		$25,260.00	$47,660.00
	2" PIPING	100	LF	$5.30	$530.00	0.12	$5.90		$590.00	$1,120.00
	3/4" PIPING	50	LF	$2.08	$104.00	0.11	$5.40		$270.00	$374.00
	8" INSULATION	400	LF	$2.23	$892.00	0.16	$8.00		$3,200.00	$4,092.00
	2" INSULATION	100	LF	$0.80	$80.00	0.08	$4.00		$400.00	$480.00
	3/4" INSULATION	50	LF	$0.28	$14.00	0.07	$3.50		$175.00	$189.00
	150 GAL EXP TANK	1	EA	$845.00	$845.00	4.00	$200.00		$200.00	$1,045.00
	FILL VALVE ASSEMBLY	1	EA	$113.00	$113.00	0.42	$21.05		$21.05	$134.05
	MANUAL AIR VENT	1	EA	$35.00	$35.00	0.67	$33.35		$33.35	$68.35
	1" STRAINER	1	EA	$13.75	$13.75	0.47	$23.55		$23.55	$37.30
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00		$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$1,053.00	$1,053.00	6.00	$300.00		$300.00	$1,353.00
	Subtotals:				$550,286.35				$144,324.75	$704,611.10
	Sales Tax:				$0.00					

Overhead:	10%	$70,461.11
Profit:	10%	$77,507.22
Subtotal:		$852,579.43
Bond:		$0.00
Contingency:	15%	$127,886.91
Grand Total:		$980,466.35

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-5
Date:	August 02 1995
Prepared By:	GRH
Sheet:	PAGE 2
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	CONDENSER WTR SYS									
	PUMPS 2328 GPM	1	EA	$5,773.00	$5,773.00	24.00	$1,200.00		$1,200.00	$6,973.00
	GRISWOLD SEPARATOR	1	EA	$4,750.00	$4,750.00	8.00	$400.00		$400.00	$5,150.00
	10" BUTTERFLY VALVE	6	EA	$425.00	$2,550.00	6.00	$300.00		$1,800.00	$4,350.00
	PRESSURE GAGES	3	EA	$16.50	$49.50	0.25	$12.50		$37.50	$87.00
	BALANCING VALVES	1	EA	$56.00	$56.00	0.44	$22.20		$22.20	$78.20
	AUTO PURGE VALVE	1	EA	$1,050.00	$1,050.00	0.73	$36.35		$36.35	$1,086.35
	1"BALL VALVES	6	EA	$12.20	$73.20	0.42	$21.05		$126.30	$199.50
	FLEXIBLE CONNECTOR	3	EA	$340.00	$1,020.00	4.50	$225.00		$675.00	$1,695.00
	1-1/2" STRAINERS	2	EA	$47.00	$94.00	0.57	$28.55		$57.10	$151.10
	THERMOMETERS	2	EA	$33.00	$66.00	0.25	$12.50		$25.00	$91.00
	GAGE COCKS	7	EA	$12.20	$85.40	0.42	$21.05		$147.35	$232.75
	10" PIPING	400	LF	$73.00	$29,200.00	1.50	$75.00		$30,000.00	$59,200.00
	3" PIPING	50	LF	$6.60	$330.00	0.37	$18.60		$930.00	$1,260.00
	2" VENT PIPING	10	LF	$4.12	$41.20	0.26	$13.10		$131.00	$172.20
	1" DRAIN PIPING	15	LF	$2.18	$32.70	0.15	$7.55		$113.25	$145.95
	1-1/2" BALL VALVES	3	EA	$18.05	$54.15	0.62	$30.75		$92.25	$146.40
	CHEM FEED PUMP/TAN	1	EA							$2,000.00
	SOLENOID VALVE	1	EA	$410.00	$410.00	0.75	$37.50		$37.50	$447.50
	3" BUTTERFLY VALVES	2	EA	$185.00	$370.00	2.00	$100.00		$200.00	$570.00
	TRIPLE DUTY VALVE	1	EA	$2,208.00	$2,208.00	8.00	$400.00		$400.00	$2,608.00
	SUCTION DIFFUSER	1	EA	$2,093.00	$2,093.00	6.00	$300.00		$300.00	$2,393.00
	Subtotals:				$50,306.15			0.00	$36,730.80	$89,036.95
	Sales Tax:				$0.00					

Overhead:	10%	$8,903.70
Profit:	10%	$8,903.70
Subtotal:		$106,844.34
Bond:		$0.00
Contingency:	15%	$16,026.65
Grand Total:		$122,870.99

Kuhlmann Design Group, Inc.

Project Name:	COE FLW THERMAL STORAGE
Project Number:	930073-0017 ALTERNATIVE IT-5
Date:	August 02, 1995
Prepared By:	GRH
Sheet:	PAGE 3
Department:	MECHANICAL-HVAC

Base Labor Rate:	
City Multiplier:	0%
Effective Labor Rate:	$50.00

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	HRS/UNIT	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	PROJ MAN/ MISC COSTS	1	LS		$0.00		$0.00	0.00	$0.00	$29,500.00
	SEISMIC	1	LS		$0.00		$0.00	0.00	$0.00	$10,000.00
	CONTROLS	1	LS		$0.00		$0.00	0.00	$0.00	$96,750.00
	BALANCING	1	LS		$0.00		$0.00	0.00	$0.00	$4,000.00

Subtotals:	$0.00	0.00	$0.00	$140,250.00
Sales Tax:	$0.00			

Overhead:	10%	$14,025.00
Profit:	10%	$14,025.00
Subtotal:		$168,300.00
Bond:		$0.00
Contingency:	15%	$25,245.00
Grand Total:		$193,545.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study - Alt. IT-5
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	1 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Chiller #1 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
1	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
2	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
3	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
4	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
5	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
6	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
7	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
8	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
9	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
10	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
11	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
12	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chiller #2 Replacement				$0.00		$0.00	0.00	$0.00	$0.00
13	Demolition	1	LOT	n/a	$0.00	86.64	$2,820.00	86.64	$2,820.00	$2,820.00
14	Shielded, 5kv, #3/0, cu. w	180	L.F.	$2.75	$504.00	0.04	$1.43	7.90	$257.00	$761.00
15	Cable Termination	12	EA	$98.23	$1,200.00	1.23	$40.00	14.75	$480.00	$1,680.01
16	Grounding	1	LOT	n/a	$0.00	6.15	$200.00	6.15	$200.00	$200.00
17	2 1/2" Rigid Conduit	40	L.F.	$5.60	$228.00	0.18	$5.70	7.01	$228.00	$456.00
18	2 1/2" Rigid Connector	6	EA	$7.86	$48.00	1.23	$40.00	7.37	$240.00	$288.00
19	2 1/2" Conduit Hanger	4	EA	$9.82	$40.00	0.61	$20.00	2.46	$80.00	$120.00
20	2 1/2" Flex Conduit	5	L.F.	$2.16	$11.00	0.23	$7.60	1.17	$38.00	$49.00
21	2 1/2" Flex Connector	2	EA	$23.58	$48.00	0.35	$11.50	0.71	$23.00	$71.00
22	5kv Fuse	3	EA	$294.70	$900.00	4.82	$157.00	14.47	$471.00	$1,371.00
23	2" Elbow	2	EA	$22.60	$46.00	0.88	$28.50	1.75	$57.00	$103.00
24	Connection to Equipment	1	LOT	n/a	$0.00	7.99	$260.00	7.99	$260.00	$260.00
					$0.00		$0.00	0.00	$0.00	$0.00
	Chilled Water Pump-40hp				$0.00		$0.00	0.00	$0.00	$0.00
25	#1/0 thwn cu. conductor	150	L.F.	$1.14	$173.40	0.02	$0.65	3.00	$97.64	$271.04
26	1 1/4" EMT conduit	40	L.F.	$1.21	$49.27	0.08	$2.60	3.20	$104.15	$153.42
27	150amp fuse	3	EA	$29.00	$88.57	0.20	$6.51	0.60	$19.53	$108.09
28	Connection to Equipment	1	EA	$20.00	$20.36	4.00	$130.19	4.00	$130.19	$150.55
29	Combo. Starter/Disc.	1	EA	$1,360.51	$1,385.00	10.60	$345.00	10.60	$345.00	$1,730.00
30	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.71	0.57	$18.55	$24.00
31	1 1/4" Flex Connector	2	EA	$6.38	$12.98	0.20	$6.51	0.40	$13.02	$26.00
32	150amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
33	New 1000kva Transforme	1	EA	$15,000.0	$15,270.00	54.25	$1,765.67	54.25	$1,765.67	$17,035.67
					$0.00		$0.00	0.00	$0.00	$0.00
34	Disposal of existing trans.	1	EA	$2,946.95	$3,000.00	30.72	$1,000.00	30.72	$1,000.00	$3,999.99
					$0.00		$0.00	0.00	$0.00	$0.00
35	New Primary for Trans.	1	LOT	n/a	$0.00	460.87	$15,000.00	460.87	$15,000.00	$15,000.00

Kuhlmann Design Group, Inc.

Project Name:	Ft. Leonardwood Chiller Study
Project Number:	930073-0017
Date:	August 17, 1995
Prepared By:	S. Benway
Sheet:	2 of 2
Department:	Electrical

Base Labor Rate:	$28.50
City Multiplier (Labor):	114%
Effective Labor Rate:	$32.55

City Multiplier (Material):	102%

ESTIMATE OF CONSTRUCTION COST

ITEM				MATERIAL		LABOR				MATERIAL/ LABOR
#	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL	RS/UNI	COST/UNIT	TOTAL HRS	TOTAL COST	TOTAL
	Cooling Tower Fan-60hp				$0.00		$0.00	0.00	$0.00	$0.00
36	#2/0 thwn cu. conductor	150	L.F.	$1.17	$178.66	0.03	$0.98	4.50	$146.46	$325.12
37	2" EMT conduit	40	L.F.	$1.91	$77.78	0.10	$3.25	4.00	$130.19	$207.96
38	200amp fuse	3	EA	$22.50	$68.72	0.22	$7.23	0.67	$21.68	$90.39
39	Connection to Equipment	1	EA	$300.00	$305.40	20.00	$650.94	20.00	$650.94	$956.34
40	Combo. Starter/Disc.	1	EA	$1,943.67	$1,978.66	16.00	$520.75	16.00	$520.75	$2,499.41
41	2" Flex Conduit	5	L.F.	$1.80	$9.16	0.20	$6.51	1.00	$32.55	$41.71
42	2" Flex Connector	2	EA	$12.30	$25.04	0.35	$11.33	0.70	$22.65	$47.70
43	200amp switch in Panel	1	EA	$1,000.00	$1,018.00	8.00	$260.38	8.00	$260.38	$1,278.38
					$0.00		$0.00	0.00	$0.00	$0.00
	Cond. Water Pump-25hp				$0.00		$0.00	0.00	$0.00	$0.00
44	#4 thwn cu. conductor	180	L.F.	$0.39	$71.46	0.02	$0.65	3.60	$117.17	$188.63
45	1 1/4" EMT conduit	50	L.F.	$1.21	$61.59	0.08	$2.60	4.00	$130.19	$191.78
46	90amp fuse	3	EA	$10.15	$31.00	0.20	$6.51	0.60	$19.53	$50.53
47	Connection to Equipment	1	EA	$30.00	$30.54	4.09	$133.17	4.09	$133.17	$163.71
48	Combo. Starter/Disc.	1	EA	$1,356.58	$1,381.00	10.60	$345.00	10.60	$345.00	$1,726.00
49	1 1/4" Flex Conduit	5	L.F.	$1.07	$5.45	0.11	$3.58	0.55	$17.90	$23.35
50	1 1/4" Flex Connector	2	EA	$6.38	$12.99	0.20	$6.51	0.40	$13.02	$26.01
51	100amp switch in Panel	1	EA	$918.38	$934.91	2.00	$65.09	2.00	$65.09	$1,000.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00
					$0.00		$0.00	0.00	$0.00	$0.00

Subtotals:	$33,180.28	967.63	$31,493.50	$64,673.78
Sales Tax:	0%	$0.00		

Overhead:	10%	$6,467.38
Profit:	10%	$7,114.12
Subtotal:		$78,255.28
Bond:	0%	$0.00
Contingency:	10%	$7,825.53
Grand Total:		$86,080.81

APPENDIX H

LIFE CYCLE COST ANALYSIS COMPUTER PRINTOUTS

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-1
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 769817.
B. SIOH $ 85406.
C. DESIGN COST $ 93171.
D. TOTAL COST (1A+1B+1C) $ 948394.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 948394.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	11.	$ 282.	15.88	$ 4472.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 9203.	14.88	$ 136941.
N. TOTAL		11.	$ 9485.		$ 141412.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 9485.

5. SIMPLE PAYBACK PERIOD (1G/4) 99.99 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 141412.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .15
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -6.35 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-2
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 1920564.
B. SIOH $ 148698.
C. DESIGN COST $ 162215.
D. TOTAL COST (1A+1B+1C) $ 2231477.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 2231477.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-210.	$ -5247.	15.88	$ -83317.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		-210.	$ 43070.		$ 635640.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 43070.

5. SIMPLE PAYBACK PERIOD (1G/4) 51.81 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 635640.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .28
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -3.27 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID . FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017   COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996   DISCRETE PORTION NAME: ECO IH-3
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 761083.		
B. SIOH	$ 84926.		
C. DESIGN COST	$ 92647.		
D. TOTAL COST (1A+1B+1C)	$ 938656.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 938656.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-15.	$ -379.	15.88	$ -6022.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 9500.	14.88	$ 141360.
N. TOTAL		-15.	$ 9121.		$ 135338.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 9121.

5. SIMPLE PAYBACK PERIOD (1G/4) 102.91 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 135338.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .14
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -6.51 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-4
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 972958.		
B. SIOH	$ 96469.		
C. DESIGN COST	$ 105239.		
D. TOTAL COST (1A+1B+1C)	$ 1174666.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1174666.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-217.	$ -5419.	15.88	$ -86061.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		-217.	$ 42898.		$ 632896.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 42898.

5. SIMPLE PAYBACK PERIOD (1G/4) 27.38 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 632896.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .54
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -.14 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IH-5
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 877121.		
B. SIOH	$ 91275.		
C. DESIGN COST	$ 99573.		
D. TOTAL COST (1A+1B+1C)	$ 1067969.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1067969.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	-54.	$ -1361.	15.88	$ -21615.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		-54.	$ 46956.		$ 697342.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 46956.

5. SIMPLE PAYBACK PERIOD (1G/4) 22.74 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 697342.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .65
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): .83 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-1
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 400815.		
B. SIOH	$ 65060.		
C. DESIGN COST	$ 70974.		
D. TOTAL COST (1A+1B+1C)	$ 536849.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 536849.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	11.	$ 282.	15.88	$ 4472.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 14918.	14.88	$ 221980.
N. TOTAL		11.	$ 15200.		$ 226452.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A.X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 15200.

5. SIMPLE PAYBACK PERIOD (1G/4) 35.32 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 226452.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .42
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -1.35 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOP
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-2
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 500510.
B. SIOH $ 70543.
C. DESIGN COST $ 76956.
D. TOTAL COST (1A+1B+1C) $ 648009.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 648009.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	74.	$ 1853.	15.88	$ 29426.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 18110.	14.88	$ 269477.
N. TOTAL		74.	$ 19963.		$ 298903.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 19963.

5. SIMPLE PAYBACK PERIOD (1G/4) 32.46 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 298903.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .46
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -.91 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-3
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 859365.		
B. SIOH	$ 90423.		
C. DESIGN COST	$ 98643.		
D. TOTAL COST (1A+1B+1C)	$ 1048431.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1048431.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	9.	$ 235.	15.88	$ 3727.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		9.	$ 48552.		$ 722684.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 48552.

5. SIMPLE PAYBACK PERIOD (1G/4) 21.59 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 722684.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .69
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 1.10 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017   COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996   DISCRETE PORTION NAME: ECO IT-4
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT

A. CONSTRUCTION COST	$ 787991.	
B. SIOH	$ 86433.	
C. DESIGN COST	$ 94290.	
D. TOTAL COST (1A+1B+1C)	$ 968714.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 968714.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	42.	$ 1039.	15.88	$ 16506.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		42.	$ 49356.		$ 735463.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
  (1) DISCOUNT FACTOR (TABLE A)   14.88
  (2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 49356.

5. SIMPLE PAYBACK PERIOD (1G/4)   19.63 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 735463.

7. SAVINGS TO INVESTMENT RATIO   (SIR)=(6 / 1G)=   .76
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):   1.59 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FLWSTOR
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT LEONARD WREGION NOS. 7 CENSUS: 2
PROJECT NO. & TITLE: 930073-0017 COLD THERMAL STORAGE ANALYSIS
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO IT-5
ANALYSIS DATE: 08-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: T. J. GRANT

1. INVESTMENT
A. CONSTRUCTION COST $ 599942.
B. SIOH $ 76076.
C. DESIGN COST $ 82992.
D. TOTAL COST (1A+1B+1C) $ 759010.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 759010.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 25.00	50.	$ 1257.	15.88	$ 19954.
B. DIST	$ .00	0.	$ 0.	19.16	$ 0.
C. RESID	$ .00	0.	$ 0.	21.43	$ 0.
D. NAT G	$ .00	0.	$ 0.	18.30	$ 0.
E. COAL	$ .00	0.	$ 0.	16.62	$ 0.
F. PPG	$ .00	0.	$ 0.	18.20	$ 0.
M. DEMAND SAVINGS			$ 48317.	14.88	$ 718957.
N. TOTAL		50.	$ 49574.		$ 738911.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 49574.

5. SIMPLE PAYBACK PERIOD (1G/4) 15.31 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 738911.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .97
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 2.86 %